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Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Alaska Region

by U.S. Army Corps of Engineers

Contents

Preface

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual. It was developed by the U.S. Army Engineer Research and Development Center (ERDC) at the request of Headquarters, U.S. Army Corps of Engineers (USACE), with funding provided through the Wetlands Regulatory Assistance Program (WRAP).

This document was developed in cooperation with the Alaska Regional Working Group, whose members contributed their time and expertise to the project over a period of many months. Working Group meetings were held in Anchorage, AK, on 3-5 February and 16-17 November 2004. Members of the Regional Working Group and contributors to this document were:

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Technical editors for this Regional Supplement were Dr. James S. Wakeley, Mr. Robert W. Lichvar, and Mr. Chris V. Noble, ERDC. Ms. Katherine Trott was the project proponent and coordinator at Headquarters, USACE. During the conduct of this work, Dr. Morris Mauney was Chief of the Wetlands and Coastal Ecology Branch; Dr. David Tazik was Chief, Ecosystem Evaluation and Engineering Division; and Dr. Edwin Theriot was Director, EL. Dr. James Houston was Director and COL James Rowan was Commander of ERDC.

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1 – Introduction

Purpose and Use of this Regional Supplement

This document is one of a series of Regional Supplements to the Corps of Engineers Wetland Delineation Manual (hereafter called the Corps Manual). The Corps Manual provides technical guidance and procedures, from a national perspective, for identifying and delineating wetlands that may be subject to regulatory jurisdiction under Section 404 of the Clean Water Act (33 U.S.C. 1344). According to the Corps Manual, identification of wetlands in most cases is based on a three-factor approach involving indicators of hydrophytic vegetation, hydric soil, and wetland hydrology. Indicators are generally site-specific but should be evaluated in a broader context including landscape position, human influences, and other factors. This Regional Supplement presents wetland indicators, delineation guidance, and other information that is specific to the Alaska Region.

This Regional Supplement is part of a nationwide effort to address regional wetland characteristics and improve the accuracy and efficiency of wetland-delineation procedures. Regional differences in climate, geology, soils, hydrology, plant and animal communities, and other factors are important to the identification and functioning of wetlands. These differences cannot be considered adequately in a single national manual. The development of this supplement follows National Academy of Sciences recommendations to increase the regional sensitivity of wetland-delineation methods (National Research Council 1995).

This Regional Supplement is designed for use with the current version of the Corps Manual (Environmental Laboratory 1987) and all subsequent versions. Where differences in the two documents occur, this Regional Supplement supersedes the Corps Manual for applications in the Alaska Region. The procedures given in the Corps Manual, in combination with wetland indicators provided in this supplement, can be used to identify wetlands for a number of purposes, including land-use planning, resource inventories, management plans, and regulatory programs. The determination that a wetland is subject to regulatory jurisdiction under Section 404 must be made independently of procedures described in this supplement.

Indicators and procedures given in this Supplement are designed to identify wetlands as defined jointly by the Corps of Engineers (33 CFR 328.3) and Environmental Protection Agency (40 CFR 230.3). One key feature of this definition is that wetlands, under normal circumstances, support "a prevalence of vegetation typically adapted for life in saturated soil conditions." Many waters of the US are excluded from the Corps/EPA definition of wetlands, although they may still be subject to Clean Water Act regulatory jurisdiction (33 CFR 328.3a). Waters of the US in Alaska include, but are not limited to, tidal waters, lakes, rivers, streams, mud flats, and similar areas. Delineation of these waters of the US in non-tidal areas is based on the "ordinary high water mark" (33 CFR 328.3e) or other criteria, and is beyond the scope of this Regional Supplement.

Amendments to this document will be issued periodically in response to new scientific information and user comments. Between published versions, Headquarters, U.S. Army Corps of Engineers, may provide updates to this document and any other supplemental information used to make wetland determinations under Section 404. Wetland delineators should use the most recent approved versions of this document and supplemental information. The Corps of Engineers has established an interagency National Advisory Team for Wetland Delineation whose role is to review new data and make recommendations for needed changes in wetland-delineation procedures to Headquarters, U.S. Army Corps of Engineers. Items for consideration by the Team, including full documentation and supporting data, can be submitted to:

National Advisory Team for Wetland Delineation
Regulatory Branch (Attn: CECW-CO)
U.S. Army Corps of Engineers
441 G Street, N.W.
Washington, DC 20314-1000

Applicable Region and Subregions

This supplement is applicable to the Alaska Region, which is defined herein as the entire State of Alaska (Figure 1-1). The Alaska Region is differentiated from other regions in the United States in part by its climate, which is typical of high latitudes. Alaska is characterized by a humid temperate climate along the southeastern coast and a polar climate across the rest of the state (Bailey 1998). The polar climate is controlled mainly by polar and arctic air masses. In general, temperatures are low, winters are severe, and annual precipitation is low, much of it occurring during summer. Although day length during summer can be long, the intensity of solar radiation and potential for evapotranspiration are relatively low. Soils are usually frozen during the winter and the growing season is short.

The humid temperate climate of southeastern Alaska is influenced by both polar and tropical air masses and is characterized by warmer temperatures and abundant precipitation. Summers tend to be cool and moist, and the annual temperature range is relatively narrow due to the proximity of the ocean (Bailey 1995, 1998).

Within the Alaska Region, this supplement recognizes six subregions that differ sufficiently from each other in climate, landforms, biogeography, and wetland characteristics to warrant separate consideration of wetland indicators and delineation guidance. The boundaries and names of four of these subregions correspond to the following Land Resource Regions (LRR) in Alaska recognized by the U. S. Department of Agriculture, Natural Resources Conservation Service (USDA Natural Resources Conservation Service 2004): Aleutian Alaska, Interior Alaska, Northern Alaska, and Western Alaska. For the purposes of this supplement, the fifth LRR (Southern Alaska) has been split into two subregions – Southcentral Alaska and Southeast Alaska – based on differences in climate that affect vegetation and other wetland characteristics. The six subregions (Figure 1-1) are described later in this chapter. However, most of the indicators presented in this Regional Supplement are applicable across all subregions in the State.

Subregion boundaries are depicted in Figure 1-1 as sharp lines. However, climatic conditions and the physical and biological characteristics of landscapes do not change abruptly at the boundary. In reality, subregions may grade into one another in broad transition zones that may be tens or hundreds of miles wide. Where the depicted boundary follows a broad mountain range, such as the Brooks Range, north-facing slopes may have climatic conditions similar to those of the more northerly subregion and south-facing slopes may have a climate similar to that of the more southerly subregion. In some cases, wetland indicators presented in this Regional Supplement may differ between adjoining subregions. In transition areas, the investigator must use experience and good judgment to select the indicators that are appropriate to the site based on its physical and biological characteristics relative to those described below for the adjoining subregions.

Figure 1-1. Alaska Region and subregions. Only part of the Aleutian Island chain is shown.

Physical and Biological Characteristics of the Region

The Alaska Region encompasses a vast area that extends over 2,400 miles (3,860 km) east to west and over 1,400 miles (2,250 km) north to south. Alaska's land surface covers more than 586,000 square miles (1,517,700 km^2), most of which is located north of 60° N latitude and extends well above the Arctic Circle. Climate, geology, and landforms are highly variable across the region. Northern portions of Alaska are underlain by continuous permafrost, which becomes discontinuous, isolated, and fades away toward the south. Plant communities are also spatially variable, ranging from the grass, sedge, lichen, and dwarf-shrub communities of the arctic tundra to the coniferous rainforests of southeastern Alaska. The following descriptions of each subregion were excerpted and adapted from USDA Natural Resources Conservation Service (2004).

Aleutian Alaska

This subregion includes the southwest portion of the Alaska Peninsula, the Aleutian Islands, and the Pribilof Islands (Figure 1-1). Elevation ranges from sea level to more than 4,000 feet (1,220 m). The subregion makes up approximately 6.8 million acres (2.8 million ha) or about 2% of Alaska. Cool temperatures, strong winds, fog, overcast skies, and abundant precipitation characterize the maritime climate of the subregion. Average annual precipitation ranges from about 21 inches to more than 78 inches (530 to 1,980 mm). Annual snowfall is 30 to 85 inches (75 to 215 cm) and is generally limited to higher elevations. The average annual air temperature ranges from 36 to 39 °F (2 to 4 °C). The frost-free period ranges from May to mid-September.

Volcanoes (many of which are active), lava flows, and tilted fault blocks of volcanic-derived sediments make up much of the subregion. Landforms include steep mountain slopes, rolling hills, and steep-walled fjords and sea cliffs. The eastern portion of the subregion has been glaciated. The subregion is free of permafrost.

Soil texture grades from coarse scoria and cinders to fine sand and silt with increasing distance from the volcanoes. Bare rock and rubble occur on the steep slopes of volcanic cones, peaks, and high ridges. Poorly decomposed, saturated organic materials occur in depressions and broad valley bottoms.

There are no trees in this subregion. Dwarf scrub vegetation occurs at the higher elevations and in areas exposed to the wind. The more protected areas have mesic graminoid herbaceous vegetation.

Interior Alaska

This subregion includes the vast interior of Alaska, from the south slope of the Brooks Range to the north slope of the Alaska Range. It also includes the Copper River Basin and its surrounding mountains (Figure 1-1). The Yukon, Tanana, and Kuskokwim Rivers drain the majority of this subregion to the west into the Bering Sea. Most of the Copper River Basin drains to the Gulf of Alaska via the Copper River. Elevation ranges from 100 feet (30 m) along the

Yukon River in the west to 20,320 feet (6,195 m) at the summit of Mt. McKinley. The subregion makes up approximately 166 million acres (67 million ha) or 45% of Alaska.

The subarctic continental climate is dry and cold, with short, warm summers and long, cold winters. The mean annual precipitation across the subregion ranges from about 6 inches in the northwest lowlands to 100 inches or more (152 to 2,540 mm) in the Alaska Range. In the summer, afternoon thunderstorms are common in valleys and at lower elevations in the mountains. Lightning-caused wildfires often burn thousands of acres. Mean annual temperatures across the subregion range from 8 to 28 °F (-10 to -3 °C), with the most variation in the mountainous areas. Frost may occur in any month.

The subregion consists of floodplains, broad alluvial plains and terraces, hills, mountain slopes, and ridges. The mountains surrounding the subregion consist of folded and faulted strata that were extensively glaciated during the Pleistocene epoch, although lower elevations remained unglaciated. The intermountain basins of the Yukon Flats and Interior Alaska Lowlands are broad Pleistocene and Holocene floodplains and terraces. The Copper River Plateau, to the southeast, is a higher basin with broad alluvial and lacustrine terraces and glacial landforms.

This subregion is in the zone of discontinuous permafrost and not all soils have permafrost in their profile. The permafrost in this subregion is warmer than that in the Northern Alaska subregion and is near 30° F (-1 °C). The distribution of permafrost soils is determined by landform position, particle size, vegetation, and moisture content of the soil. Much of the area on the flanks of the Brooks Range and Alaska Range is covered by rock, snow, and ice. Here, the non-permafrost soils occur on steeper slopes with coarser textured parent materials. Wildfires disturb the insulating organic surface, lowering the permafrost table and eliminating perched water tables. Depending on fire frequency, landform position, and particle size, these soils may or may not revert back to permafrost. Depressional landforms across the subregion contain saturated organic materials. These organic soils include soils with permafrost and soils without permafrost.

The native vegetation across the subregion ranges from boreal forests to alpine tundra. The southern Brooks Range and the flanks of the Alaska Range are dominated by alpine tundra with grasses, sedges, mosses, lichens, ericaceous shrubs, and willows. The low hills and mountains are a mix of alpine tundra and boreal forests. The basins are predominantly boreal forests with black spruce (*Picea mariana*), white spruce (*P. glauca*), paper birch (*Betula papyrifera*), and quaking aspen (*Populus tremula*).

Northern Alaska

This subregion includes the northern slope of the Brooks Range, the western Brooks Range and the northern and western Seward Peninsula (Figure 1-1). Except for the western Seward Peninsula, the area drains to the north and west into the Arctic Ocean and Chukchi Sea. The western Seward Peninsula drains into the northern Bering Sea. The majority of the subregion is above the Arctic Circle, and consequently receives several weeks of continuous sunlight in summer and several weeks of continuous darkness in winter. At Barrow, the sun is continuously above the horizon from May 10 to August 2 and continuously below the horizon from November 18 to January 23. The subregion is in the zone of continuous permafrost. Permafrost is shallow to moderately deep except on steep, coarse-textured soils in the high mountains. Periglacial features, such as patterned ground, pingos, beaded drainages, and gelifluction lobes, are common throughout. Elevation ranges from sea level on the coast to 8,570 feet (2,612 m) at the summit of Mt. Igikpak in the Brooks Range. The subregion makes up approximately 80 million acres (33 million ha) or 22% of Alaska.

The arctic climate is dry and cold, characterized by very short summers and long winters. The mean annual precipitation ranges from about 4 to 10 inches (102 to 254 mm) at lower elevations in the north and west to 30 to 40 inches (762 to 1,016 mm) at higher elevations. The mean annual temperature ranges from 8 to 22 °F (-13.3 to -5.6 °C). The recorded maximum temperature at Barrow is 80 °F (26.7 °C) and minimum is -56 °F (-48.5 °C). Freezing temperatures can occur in any month.

The subregion consists of mountains, foothills, and extensive coastal plains and deltas. The north flanks of the Brooks Range consist of folded and faulted strata. The mountains were extensively glaciated during the Pleistocene epoch. To the north, the rolling hills, ridges, and plateaus extend to the gently rolling to level, unglaciated Arctic Coastal Plain. The southwest portion of the subregion, extending into the Seward Peninsula, contains floodplains, rolling lowlands, and mountains. Gelifluction lobes and patterned ground are on many landforms and provide evidence of periglacial processes.

Hydric soils can often be found on the gentler slopes and on poorly drained hillsides. Saturated organic deposits occur in depressions throughout the subregion.

The native vegetation on foothills and lowlands is arctic tundra composed of grasses, sedges, mosses, lichens, ericaceous shrubs, and willows. Mountainous areas are dominantly alpine tundra with dwarf scrub communities. Here, sedges and lichens dominate the ground cover. Forested communities occur along the lower Noatak and Kobuk Rivers in the western part of the subregion.

Southcentral Alaska

This subregion consists of the combined Major Land Resource Areas (MLRA) 221, 223, 224, and 225 of the USDA Natural Resources Conservation Service (2004). It includes the lowlands and mountains of Cook Inlet, Kodiak Island, and the southern portion of the Alaska Peninsula (Figure 1-1). Total size of the subregion is approximately 27 million acres (11 million ha) or about 7% of the State. Elevation ranges from sea level along the coast to 20,320 feet (6,195 m) at the summit of Mount McKinley.

The climate varies from maritime along the coast to transitional maritime-continental in the northern Cook Inlet Lowlands. The average annual precipitation ranges from about 15 inches (380 mm) in the central Cook Inlet Lowlands to over 100 inches (2,540 mm) in the Cook Inlet Mountains, southern Alaska Peninsula Mountains, and the Kodiak Archipelago. The average annual snowfall ranges from about 30 inches (76 cm) in the southwestern portion of the Kodiak Archipelago to 400 inches (1,000 cm) in the Cook Inlet Mountains. The average frost-free period ranges from 60 to 80 days in the Cook Inlet Mountains to 85 to 200 days in the Kodiak Archipelago. At higher elevations, freezing temperatures can occur during every month.

The entire subregion except for the highest peaks was covered with glacial ice during the late Pleistocene epoch. At times during the early and middle Pleistocene, ice dams at the lower end of Cook Inlet covered much of the Cook Inlet Lowlands with a large glacial lake. Surficial deposits in the subregion are a complex mixture of glacial till, outwash, colluvium, alluvium, glacio-lacustrine deposits, and eolian deposits of loess and volcanic ash.

The higher elevations consist of rugged mountains with bare rock, talus, glaciers, and ice fields. Rolling hills, glacial moraines, alluvial fans, and large outwash plains extend from the mountains to the often-rugged coastline. Broad floodplains, terraces, and deltas flank the numerous glacial and freshwater drainages. Some permafrost occurs in the northern portion of the subregion in small isolated depressions and on north-facing slopes.

Hydric soils are common on floodplains, low terraces, and toe slopes. Saturated organic soils occur throughout the subregion on level and depressional landforms, and even on steeper slopes along the coast.

Alpine and sub-alpine vegetation is present on the mountain slopes. Low willow scrub is common in mountain drainages, and lichens, scattered herbs, and dwarf shrubs dominate bedrock exposures and very shallow soils. There is little or no plant growth above about 7,500 feet (2,290 m) elevation. Moving downslope, the vegetation transitions into sub-alpine meadows and tall and dwarf scrub. The lower elevations of the Cook Inlet Lowlands have mixed forests of white spruce, black spruce, paper birch, and willows. Stunted black spruce grades into scrub and herbaceous communities in fens and bogs. Along the coast of Cook Inlet are halophytic sedge and sedge-grass meadows. Coastal forests are dominated by Sitka spruce (*P. sitchensis*). Black cottonwood (*Populus balsamifera*), mixed spruce-cottonwood forests, willow scrub, alder scrub, and herbaceous communities occur on floodplains.

Southeast Alaska

This subregion corresponds to MLRA 220 and 222 of the USDA Natural Resources Conservation Service (2004). It includes the coastal islands and mountain ranges from the Alexander Archipelago in southeastern Alaska, north and west along the coast of the Gulf of Alaska and Prince William Sound, to the southern tip of the Kenai Peninsula (Figure 1-1). The subregion occupies about 34 million acres (14 million ha) or 9% of Alaska.

Cloudy skies, moderate to cold temperatures, and abundant rainfall characterize the subregion’s temperate maritime climate. In the lower elevation coastal areas, the average annual precipitation is 25 to 200 inches (635 to 5,080 millimeters). The average annual snowfall ranges from about 30 to 70 inches (76 to 178 centimeters) along the coast. The average annual temperature at lower elevations ranges from about 37 °F (2.7 °C) in the northwest to 46 °F (7.7 °C) in the southeast. The average frost-free period is about 120 to 190 days. At the higher elevations of the Coast, St. Elias, Chugach, and Kenai Mountains, precipitation is usually abundant throughout the year. Snowfall in winter is tremendous and greatly exceeds annual melt in many places, as evidenced by the abundance and extent of glaciers and ice fields. The average annual precipitation throughout the area is 250 inches (6,350 mm) or more. The average annual snowfall ranges from about 200 to 800 inches (508 to 2,032 cm). At higher elevations, freezing temperatures are likely to occur during any month of the year.

Throughout the coastal area, glaciers, rivers, and streams have cut deep, narrow to broad valleys. In the broader valleys, there are nearly level to strongly sloping floodplains and stream terraces. Alluvial and colluvial fans and short footslopes are common in the valleys along the base of the mountains. Rocky headlands and sea cliffs are common along the coast. In the central portion of the subregion, the terrain consists primarily of strongly sloping to moderately steep outwash plains, alluvial fans, long footslopes, and floodplains. Formed by melt waters of glaciers and icefields from the adjoining mountains, floodplains in this portion of the area are generally broad, high gradient, and braided. The backdrop to these coastal areas consists of steep, rugged, high-relief mountains, massive glaciers, and ice fields. Unglaciated areas are deeply incised with narrow to broad valleys. Floodplains and stream terraces on valley floors rapidly give rise to steep alluvial fans and mountain footslopes. Elevation ranges from sea level 18,008 feet (5,489 m) at the summit of Mt. St. Elias.

Soils in the subregion formed mainly in loamy or gravelly colluvium, glacial till, alluvial deposits, and silty volcanic ash. Hydric mineral soils can be found on floodplains and low terraces. Saturated organic soils are common on footslopes, discharge slopes, valley floors, and in areas immediately above timberline. Well-drained organic soils (Cryofolists) can be found on steep mountain slopes.

Lower elevations in the subregion are usually forested with western hemlock (*Tsuga heterophyla*) and Sitka spruce. Western red cedar (*Thuja plicata*) and Alaska cedar (*Chamaecyparis nootkatensis*) become more prevalent toward the south. Black cottonwood and mixed forest types occur on floodplains. Peatlands and other sites too wet for forest growth support sedge-grass meadows and low scrub. Tall alder scrub is found on steep mountain slopes and in the subalpine zone. Bluejoint reedgrass (*Calamagrostis canadensis*) grasslands are also common in the subalpine zone. Dwarf alpine scrub, herbaceous communities, and barren ground dominate the landscape above about 2,500 to 3,000 feet (762 to 914 meters) elevation. Low willow scrub is common in drainages. Lichens, scattered herbs, and dwarf shrubs dominate bedrock exposures and very shallow soils. In general, there is little or no plant growth above about 7,500 feet (2,290 m) elevation.

Western Alaska

This subregion occupies the western part of the state near the Bering Sea from the Alaska Peninsula and Bristol Bay lowlands to the southern Seward Peninsula (Figure 1-1). The subregion includes the northern Bering Sea islands. Elevation ranges from sea level to about 7,000 feet (2,135 m). The subregion makes up approximately 59 million acres (24 million ha) or 16% of Alaska.

The climate ranges from maritime near the coast to sub-arctic continental away from the coast and at higher elevations. In the northern portion of the subregion, the winter climate becomes more continental as the ice pack forms in the Bering Sea. Summers are short and warm and winters are long and cold. Cloudy conditions are common along the coast in summer. Annual precipitation across the subregion ranges from about 13 to 80 inches (330 to 2,032 mm). Precipitation is lowest in lowland areas and the Nulato Hills and increases markedly at higher elevations of the Ahklun and Alaska Peninsula mountains. Average annual temperatures range from 25 to 40 °F (-3.9 to 4.4 °C), with the most variation in the mountainous areas. Frost may occur in any month. Strong winds, especially in the winter, are common. Snow covers the ground for approximately 7 to 9 months.

The subregion consists of diverse landforms, including mountains, hills, coastal plains, outwash plains, stream terraces, volcanic cinder cones, and dunes. Lakes and interconnecting wetlands cover as much as 80 percent of the coastal lowlands. Permafrost is discontinuous across the subregion. Permafrost is prevalent on coastal plains, terraces, and footslopes, but normally is not on steep slopes and floodplains. Patterned ground and gelifluction lobes are common in many of the permafrost-affected areas. Most of the depressional areas throughout the subregion contain saturated organic soil materials.

The predominant vegetation across most of the subregion is arctic tundra and alpine tundra dominated by low and dwarf scrub and herbaceous communities. Tussock tundra occurs across broad expanses of uplands. Wet sedge and sedge-grass meadows, sedge-moss meadows, and sedge-shrub meadows are found in coastal wetlands and poorly drained areas in drainageways. Of limited extent in valley bottoms, on well drained soils at lower elevations, are open forests and woodlands of white and black spruce and, in places, paper birch and black cottonwood. Low and tall scrub, dominated by alder and willow, are common on mid-mountain slopes and floodplains.

Types and Distribution of Wetlands

Wetlands are more abundant in Alaska than in any other region of the United States. According to the National Wetlands Inventory, wetlands (including shallow subtidal habitats in coastal areas) occupy more than 174 million acres (70 million ha) and comprise more than 43% of the State's surface area (Hall, Frayer, and Wilen 1994). Nearly 99% of Alaska's wetlands are classified as palustrine, of which approximately 67% are scrub/shrub, 25% are emergent, and 8% are forested.

Alaska's wetlands are as varied as its landscapes. They include salt marshes, bogs, muskegs, fresh marshes, swamps, and wet and moist tundra. Wetland abundance varies considerably by subregion and locale. Wetlands occupy an average of 61% of Northern and Western Alaska (approximately 93 million acres or 38 million ha of wetlands). They are least abundant in the Brooks Range (approximately 22% wetlands) and most abundant (up to 83% of the land area) in the arctic foothills and coastal plain, and in the Yukon-Kuskokwim and Selawik-Kobuk deltas. Vast expanses of treeless tundra underlain by permafrost dominate the area. More than half of all of Alaska's wetlands are located in the Northern and Western subregions.

In contrast, only about 13% of the land area in Southcentral, Southeast, and Aleutian Alaska consists of wetlands (9 million acres or 3.7 million ha). These two subregions contain about 5% of Alaska's total wetland resource. Wetlands are less abundant in the mountains (<3% wetlands) and more abundant in the southeastern lowlands (34.5% wetlands) and in the Cook Inlet-Susitna lowlands (28% wetlands). Slope wetlands are common in the Southeast due to abundant precipitation and shallow bedrock. More than one-third of the wetlands in these subregions are forested.

Approximately 44% of Interior Alaska is wetlands (total of 71 million acres or 29 million ha), with the greatest wetland abundances in the Kanuti flats (76.5% wetlands), the Koyukuk-Innoko lowlands (71.1%), and the Tanana-Kuskokwim lowlands (60.9%). Interior Alaska contains approximately 40% of the State's total wetland acreage, including millions of acres of black spruce muskeg and floodplain wetlands dominated by deciduous shrubs and emergent plants. Wetlands are common on north-facing slopes where shallow permafrost traps water near the surface. Seventy-four percent of the wetland area in the subregion is classified as scrub/shrub, 13% is forested, and 13% is emergent (Hall, Frayer, and Wilen 1994).

2 – Hydrophytic Vegetation Indicators

Introduction

In wetlands, the presence of water for long periods during the growing season exerts a controlling influence on the vegetation and dictates the kinds of plants that can establish and maintain themselves. Therefore, certain characteristics of the vegetation are strong evidence for the presence of wetlands on a site. The Corps Manual uses a plant-community approach to the evaluation of vegetation. Hydrophytic vegetation decisions are based on the assemblage of plant species on a site, rather than the presence or absence of particular indicator species. In general, hydrophytic vegetation is present when the plant community is dominated by species that can tolerate prolonged inundation or soil saturation during the growing season.

Many factors besides site wetness affect the composition of the plant community in an area, including regional climate, local weather patterns, topography, soils, and plant distributional patterns at various spatial scales. Community composition reflects the adaptive capabilities of the plant species and individuals present, superimposed on a complex spatial pattern of hydrologic, edaphic, and other environmental conditions. Disturbance factors, such as floods, fires, drought, or recent site modifications, are also important. They can set back or alter the course of plant succession, and may even change the hydrophytic status of the community. For example, intense fires in wetlands underlain by shallow permafrost and dominated by species such as black spruce (*Picea mariana*) can burn both the standing vegetation and the peat layer that insulates and helps maintain the permafrost layer. Thawing of the permafrost, as a result of intense burns, can result in improved soil drainage in some settings and can shift vegetation composition from hydrophytic to non-hydrophytic in one or more growing seasons. This shift in vegetation can last 50 to 70 years in Interior Alaska's black spruce communities before the insulating moss layer develops sufficiently to re-establish both the permafrost layer and original plant community (Viereck, Van Cleve, and Dyrness 1986). Wetland determinations in such areas depend, in part, on the investigator's assessment of the permanence of the changes in site conditions using all available information and best professional judgment.

In most cases, hydrophytic vegetation decisions are based on the wetland indicator status (Reed 1988) of dominant species in the community. However, species in the facultative categories (FACW, FAC, and FACU) are recognized as occurring in both wetlands and uplands to varying degrees. Many facultative species have adaptive strategies allowing them to inhabit various landscape positions across the moisture gradient. Although most wetlands are dominated mainly by species rated OBL, FACW, and FAC, some wetland communities cannot be identified by dominant species alone. In those cases, non-dominant plants must also be considered. Furthermore, certain uncommon wetland types in Alaska may support primarily FACU species, such as paper birch (*Betula papyrifera*) or field horsetail (*Equisetum arvense*). These situations arise in part due to the broad tolerances of certain wetland plant species that allow them to be widely distributed across the moisture gradient (i.e., ecological plasticity) or to the existence of ecotypes (i.e., populations of a species that are better adapted for life in wetlands than most members of the species). Even though a species may frequently grow in wetlands, the species may be more common or widespread in uplands simply because there is more upland habitat available for colonization. Hydrophytic vegetation indicators and procedures presented in this chapter are designed to identify the majority of wetland plant communities in Alaska. However, some wetland communities may lack any of these indicators. These situations are considered in Chapter 5 (Difficult Wetland Situations in Alaska).

People who make wetland determinations in Alaska should be able to identify most of the common wetland plants that occur in the subregion(s) where they work. Lists of common wetland species in each subregion are given in Appendix A. These lists are a subset of the *National List of Plant Species that Occur in Wetlands* (Reed 1988) and do not include any proposed changes in wetland indicator statuses. There is an interagency effort underway to subregionalize the Alaska plant list, which should help to improve the accuracy of hydrophytic vegetation determinations across the state. For Clean Water Act purposes, wetland delineators should use the latest plant lists approved by Headquarters, U.S. Army Corps of Engineers.

Growing Season

Beginning and ending dates of the growing season are needed to evaluate certain wetland indicators, such as observations of flooding, ponding, or shallow water tables on potential wetland sites. Growing season dates in Alaska may be approximated by the median dates (i.e., 5 years in 10, or 50% probability) of 28 °F (-2 °C) air temperatures in spring and fall based on long-term records gathered at National Weather Service meteorological stations (U.S. Army Corps of Engineers 2005). Growing season information is reported in WETS tables provided by the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html). Based on a preliminary analysis of data from weather stations across the state, the Corps of Engineers Alaska District has provided a map of estimated growing season dates that may be useful when field sites are far from the nearest weather station (Special Public Notice 03-05, 25 July 2003, http://www.poa.usace.army.mil/reg/SPN_Scanned/SPN-2003-05.pdf).

Guidance on Vegetation Sampling

General guidance on sampling of vegetation for wetland-delineation purposes is given in the Corps Manual for both the Routine and Comprehensive methods. Those procedures are intended to be flexible and may need to be modified for application in a given region or on a particular site. The following guidance on vegetation sampling is intended to supplement the Corps Manual for applications in Alaska.

Plot and Sample Sizes

Hydrophytic vegetation determinations under the Corps Manual are based on samples taken in representative locations within the community. Completely random sampling of the vegetation is not required except for Comprehensive determinations or whenever representative sampling might give misleading results, such as in areas with patchy or heterogeneous plant cover. For Routine determinations in fairly uniform vegetation, one or more plots in each community are usually sufficient for an accurate determination. Sampling of a multi-layered community is usually accomplished using a graduated series of plots, one for each stratum, or a number of small plots nested within the largest plot (Figure 2-1). Nested plots can be helpful in forested stands with highly variable understories or in very diverse communities. Plant abundance data are averaged across the multiple small plots. When using nested plots, developing a species-area curve is helpful to determine the number of plots needed to assure that the majority of species associated with an area and community type have been observed (Tiner 1999). An adequate number of samples is indicated by the point at which the curve begins to level off and the probability of encountering new species declines. See Figure 2-2 for an example of a species-area curve.

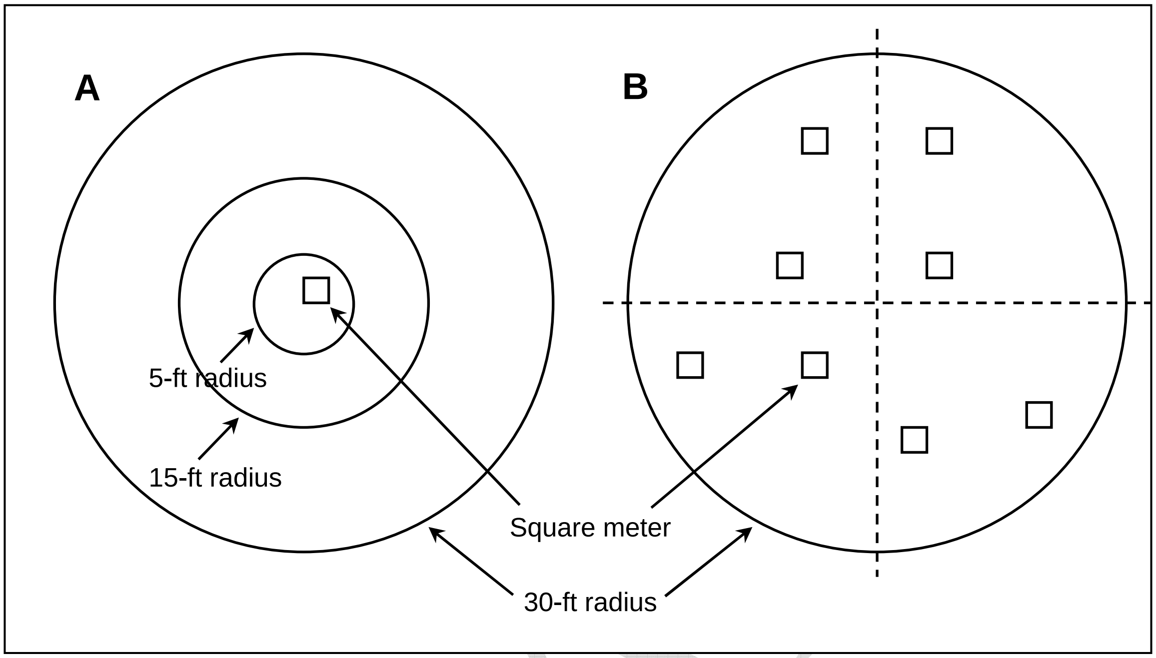

Figure 2-1. Examples of plot arrangements for vegetation sampling. (A) Single plots in graduated sizes. (B) Nested square-meter plots within the 30-ft radius plot.

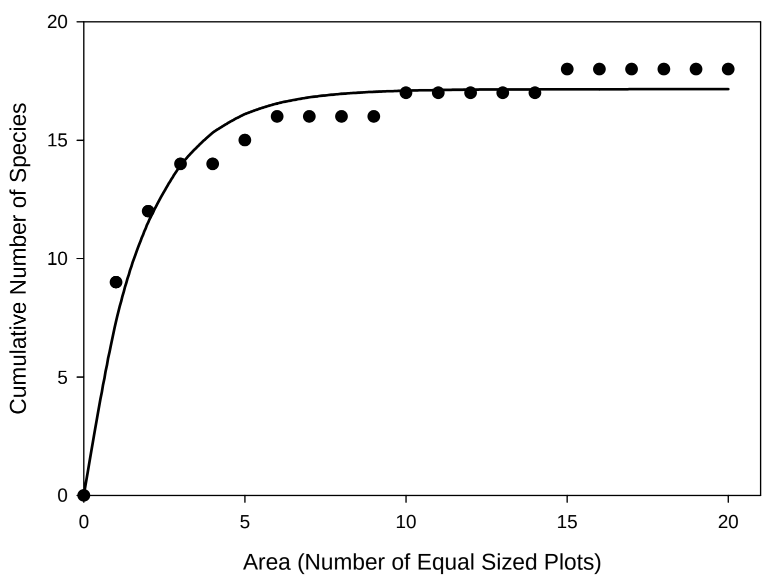

Figure 2-2. Example of a species-area curve. Solid circles indicate the cumulative number of species recorded as additional plots were sampled. In this example, approximately six to eight plots were sufficient to detect most of the species present in the community.

The appropriate size and shape for a sample plot depend on the type of vegetation (i.e., trees, shrubs, herbaceous plants, etc.) and the size or shape of the plant community or patch being sampled. The size of a plot needs to be large enough to include significant numbers of individuals in all strata, but small enough so that plant species or individuals can be separated and measured without duplication or omission, and the sampling can be done in a timely fashion (Barbour, Burk, and Pitts 1987, Cox 1990). For hydrophytic vegetation determinations, the abundance of each species is determined by using areal cover estimates. Plot sizes should make visual sampling both accurate and efficient. In Alaska, the following plot sizes are suggested.

1. Trees – 30 ft radius

2. Saplings and shrubs – 15 ft radius

3. Herbaceous plants – 5 ft radius

4. Cryptogams – 1 m (3.2 ft) square plot

The sampling plot should not be allowed to extend beyond the edges of the plant community being sampled or to overlap an adjacent community having different vegetation, soil, or hydrologic conditions. This may happen if vegetation patches are small or occur as narrow bands or zones along a topographic gradient. In such cases, plot sizes and shapes should be adjusted to fit completely within the vegetation patch or zone.

In complex forested areas or highly diverse plant communities, it may be appropriate to sample herbs or other low vegetation with nested 1-meter-square quadrants randomly located within a 30-ft radius (Figure 2-1B). Furthermore, point-intercept sampling performed along a transect (see Chapter 5) is an alternative to plot-based methods that can improve the accuracy and repeatability of vegetation sampling in diverse or heterogeneous communities (Tiner 1999).

Strata

Vegetation strata help facilitate plant sampling and ensure that plants of all sizes are considered in the hydrophytic vegetation determination. The structure of vegetation varies greatly in wetland communities across the state. Throughout much of Alaska, short-stature woody plants are an important part of many communities, such as muskegs, bogs, and tundra wetlands. Important information about the wetland status of the community can be lost when short woody plants are combined into the herb stratum for sampling, as suggested in the Corps Manual. Therefore, the following strata are recommended for use in Alaska. This system places short woody shrubs in the sapling/shrub stratum and limits the herb stratum to only herbaceous vascular plant species. Unless otherwise noted, any stratum with <5% total plant cover may be combined with the next lower stratum for sampling purposes. Sampling of the cryptogam stratum is not needed for hydrophytic vegetation indicators involving vascular plants. The cryptogam stratum is sampled only when applying Indicator 3 (Wetland Cryptogams).

1. *Tree stratum* – Consists of woody plants ≥3 inches (7.6 cm) DBH.

2. *Sapling/shrub stratum* – Consists of woody plants <3 inches DBH, regardless of height.

3. *Herb stratum* – Consists of all herbaceous (non-woody) plants, regardless of size.

4. *Cryptogam stratum* – Consists of all cryptogams (bryophytes, lichens, and fungi).

Sampling Wetland Cryptogams

Cryptogams, defined here as bryophytes (mosses, liverworts, hornworts), lichens, and fungi, form extensive ground cover in boreal forest, alpine, and polar ecosystems in Alaska. The cryptogam flora of Alaska is diverse and the identification of species is challenging even to experts due to ephemeral or missing fruiting structures and minute differences in morphological characteristics. However, based on work by Laursen, Seppelt, and Zhurbenko (2005), a list of common and relatively easy-to-identify species that are highly associated with wetlands has been developed. The Corps Manual does not specifically include cryptogams in hydrophytic vegetation decisions. However, in this regional supplement, the presence and abundance of certain wetland cryptogams are used as a positive indicator of hydrophytic vegetation in situations where indicators of hydric soil and wetland hydrology are also present.

Laursen, Seppelt, and Zhurbenko (2005) studied cryptogam species associated with black spruce wetlands in Interior and Southcentral Alaska. They identified and estimated the abundance of cryptogams on paired wetland and nonwetland test sites. These data were analyzed using probability and multivariate statistical techniques to identify species that were strongly associated with wetlands and, when sufficiently abundant, constitute a "test positive" indicator of hydrophytic vegetation. Wetland-restricted bryophytes were defined as those having ≥70% frequency of occurrence in these wetland types. By adding the requirement that these species comprise >50% of the total bryophyte cover on the sampling plot, there was >90% probability that the test site was a wetland. The list was further refined by Laursen's cryptogam team to restrict it to species that could be identified readily by trained field personnel. The reduced list was then compared to a draft wetland bryophyte list developed by the U.S. Fish and Wildlife Service (Reed 1996) and modified as needed. These efforts have identified a group of bryophytes that, if sufficiently abundant, are reliable indicators of hydrophytic vegetation (Table 2-1).

Lichens and mushrooms were also evaluated during the same study. Several mushroom species were strongly associated with wetlands but because they are highly ephemeral it was decided to drop them from further consideration as wetland indicators. The relationships of lichens to wetlands are more complex than the test data were able to explain. In general, there was an inverse relationship between lichen coverage and the coverage of wetland bryophytes. As the coverage of lichens increased, there was a decline in wetland bryophytes and the site usually lacked hydrology and soil indicators. This concept will need further refinement.

Table 2-1. List of bryophytes that are highly associated with wetlands in Interior and Southcentral Alaska.	
Aulacomnium palustre	*Polytrichum commune*
Blepharostoma trichophyllum (hepatic)	*Polytrichum strictum*
Bryum pseudotriquetrum	*Rhizomnium punctatum*
Calliergon stramineum	*Sphagnum angustifolium*
Calypogeia spp. (hepatic)	*Sphagnum fuscum*
Drepanocladus spp.	*Sphagnum papillosum*
Meesia triquetra	*Sphagnum russowii*
Meesia ulignosa	*Sphagnum squarrosum*
Mylia anomala (hepatic)	*Tomenthypnum nitens*
Pohlia proligera	

Plot Size. To make a hydrophytic vegetation determination using the cryptogam layer, areal cover estimates are needed for all bryophytes combined and for each of the wetland bryophyte taxa listed in Table 2-1. Due to the complex spatial arrangement of cryptogam species (Figure 2-3), sampling cryptogams within the 5-ft-radius herb plot is often impractical. Therefore, the recommended approach is to sample bryophytes in a 1-meter-square quadrat placed in a representative location within the herb plot (Figure 2-1A).

Identification of Cryptogams. It is intended that special training will be available at a later date to help identify common cryptogams with an emphasis on the wetland bryophyte species (Table 2-1). Until then, useful field references include "*Mosses, Lichens and Ferns of Northwest North America*" (Vitt, Marsh, and Bovey 1988) and "*Some Common Mosses of British Columbia*" (Schofield 1969). If needed, collect specimens and ask local experts to assist in their identification.

Figure 2-3. Typical complex spatial arrangement of cryptogams within a moss blanket.

Hydrophytic Vegetation Indicators

The following indicators should be applied in the sequence presented. Hydrophytic vegetation is present if any of the indicators is satisfied. However, some indicators have the additional requirement that indicators of hydric soil and wetland hydrology must also be present. These indicators are applicable in all subregions in Alaska.

The dominance test (Indicator 1) is the basic hydrophytic vegetation indicator and should be applied in every wetland determination. Most wetlands in Alaska have plant communities that will pass the dominance test, and this is the only indicator that needs to be used in most situations. However, some wetland communities may fail a test based on dominant species alone. In sample plots where indicators of hydric soil and wetland hydrology are present, the vegetation should be re-evaluated with the prevalence index (Indicator 2), which takes non-dominant plant species into consideration. Wetland cryptogams (Indicator 3) and plant morphological adaptations (Indicator 4) can be used to identify certain unusual wetland plant communities in Alaska that may not exhibit other indicators, as long as hydric soil and wetland hydrology are present. Finally, certain problematic wetland situations may lack any of these indicators and are described in Chapter 5. The procedure for using hydrophytic vegetation indicators is as follows:

1. Apply the dominance test (Indicator 1) first.
    a. If the plant community passes the dominance test, the vegetation is hydrophytic and no further vegetation analysis is required.
    b. If the plant community fails the dominance test, and indicators of hydric soil and/or wetland hydrology are absent, then hydrophytic vegetation is absent unless the site meets requirements for a problematic wetland situation (see Chapter 5).
    c. If the plant community fails the dominance test, but indicators of hydric soil and wetland hydrology are both present, proceed to the next step.

2. Calculate the prevalence index (Indicator 2). This and the following steps assume that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present.
    a. If the plant community satisfies the prevalence index, the vegetation is hydrophytic. No further vegetation analysis is required.
    b. If the plant community fails the prevalence index, proceed to the next step.

3. Apply Indicators 3 and 4.
    a. If either of the indicators is satisfied, the vegetation is hydrophytic.
    b. If none of the indicators is satisfied, then hydrophytic vegetation is absent unless indicators of hydric soil and wetland hydrology are present and the site meets the requirements for a problematic wetland situation (Chapter 5).

Indicator 1: Dominance test

Description: More than 50% of the dominant plant species across all strata are rated OBL, FACW, or FAC.

User Notes: Use the 50/20 rule described below to select dominant species from each stratum of the community. Combine dominant species across strata and apply the dominance test to the combined list. Once a species is selected as a dominant, its cover value is not used in the dominance test; each dominant species is treated equally. Thus, a plant community with seven dominant species across all strata would need at least four dominant species that are OBL, FACW, or FAC to be considered hydrophytic by this indicator. Species that are dominant in two or more strata should be counted two or more times in the dominance test.

Procedure for Selecting Dominant Species by the 50/20 Rule: Dominant plant species are the most abundant species in the community; they contribute more to the character of the community than do the other non-dominant species present. The "50/20 rule" is a repeatable and objective procedure for selecting dominant plant species and is recommended when data are available for all species in the community. The rule can also be used to guide visual sampling of plant communities in rapid wetland determinations.

Dominant species are chosen independently from each stratum of the community. In general, dominants are the most abundant species that individually or collectively account for more than 50% of the total coverage of vegetation in the stratum, plus any other species that, by itself, accounts for at least 20% of the total. For the purposes of this regional supplement, absolute percent cover is the recommended abundance measure for plants in all vegetation strata. See Table 2-2 for an example application of the 50/20 rule in evaluating a plant community. Steps in selecting dominant species by the 50/20 rule are as follows:

1. Estimate the absolute percent cover of each species in the first stratum. Since the same data may be used later to calculate the prevalence index, the data should be recorded as absolute cover and not converted to relative cover.

2. Rank all species in the stratum from most to least abundant.

3. Calculate the total coverage of all species in the stratum (i.e., sum their individual percent cover values). Absolute cover estimates do not necessarily sum to 100%.

4. Select plant species from the ranked list, in decreasing order of coverage, until the cumulative coverage of selected species *exceeds* 50% of the total coverage for the stratum. If two or more species are equal in coverage (i.e., they are tied in rank), they should be selected as a group. The selected plant species are all considered to be dominants. All dominants must be identified to species.

5. In addition, select any other species that, by itself, is at least 20% of the total percent cover in the stratum. Any such species is also considered to be a dominant and must be accurately identified.

6. Repeat steps 1-5 for any other stratum present. Combine the lists of dominant species across all strata. Note that a species may be dominant in more than one stratum (e.g., a woody species may be dominant in both the tree and sapling/shrub strata).

Table 2-2
Example of the selection of dominant species by the 50/20 rule.

Stratum	Species Name	Wetland Indicator Status	Percent Cover	Dominant?
Herb	*Matteuccia struthiopteris*	FACW	40	Yes
	Impatiens noli-tangere	FACW	20	Yes
	Equisetum arvense	FACU	10	No
	Ribes hudsonianum	FAC	10	No
	Thalictrum sparsiflorum	FACU	10	No
	Calamagrostis canadensis	FAC	5	No
	Dryopteris dilatata	FACU	5	No
	Oplopanax horridus	FACU	5	No
	Streptopus amplexifolius	FAC	5	No
		Total cover	110	
	50/20 Thresholds: 50% of total cover = 55% 20% of total cover = 22%			
Sapling/shrub	*Salix alaxensis*	FAC	80	Yes
	Populus balsamifera	FACU	10	No
	Alnus sinuata	FAC	10	No
		Total cover	100	
	50/20 Thresholds: 50% of total cover = 50% 20% of total cover = 20%			
Tree	*Populus balsamifera*	FACU	10	Yes
Hydrophytic Vegetation Determination	Total number of dominant species across all strata = 4. Percent of dominant species that are OBL, FACW, or FAC = 3/4 = 75%. Therefore, this community is hydrophytic by Indicator 1 (Dominance Test).			

Indicator 2: Prevalence index

Description: The prevalence index is ≤3.0.

User Notes: At least 80% of the total vegetation cover on the plot (summed across all strata) must be of species that have been correctly identified and have an assigned wetland indicator status.

Procedure for Calculating a Plot-Based Prevalence Index: The prevalence index is a weighted-average wetland indicator status of all plant species in the sampling plot, where each indicator status category is given a numeric code (OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5) and weighting is by abundance (percent cover). It is a more comprehensive analysis of the hydrophytic status of the community than one based on just a few dominant species. It is particularly useful (1) in communities with only one or two dominants, (2) in highly diverse communities where many species may be present at roughly equal coverage, and (3) when strata differ greatly in total plant cover (e.g., total herb cover is 90% but shrub cover is only 10%). The prevalence index is used in this supplement to determine whether hydrophytic vegetation is present on sites where indicators of hydric soil and wetland hydrology are present but the vegetation initially fails the dominance test.

The following procedure is used to calculate a plot-based prevalence index. The method was described by Wentworth et al. (1988) and modified by Wakeley and Lichvar (1997). It uses the same field data (i.e., percent cover estimates for each plant species) that were used to select dominant species by the 50/20 rule, with the added constraint that at least 80% of the total vegetation cover on the plot must be of species that have been correctly identified and have an assigned indicator status. For any species that occurs in more than one stratum, cover estimates are summed across strata. Steps for determining the prevalence index are as follows:

1. Identify and estimate the absolute percent cover of each species in each stratum of the community. Sum the cover estimates for any species that is present in more than one stratum.

2. Organize all species (across all strata) into groups according to their wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL) and sum their cover values within groups. Do not include species that were not identified. Species that were identified correctly but are not listed on the wetland plant list are assumed to be upland (UPL) species. For species with no regional indicator (NI), apply the national indicator status to the species. If no regional indicator is assigned and more than one national indicator status is assigned, do not use the species to calculate the prevalence index. If the species is listed but no regional or national indicator is assigned, do not use the species.

3. Calculate the prevalence index using the following formula:

$$PI = \frac{A_{OBL} + 2A_{FACW} + 3A_{FAC} + 4A_{FACU} + 5A_{UPL}}{A_{OBL} + A_{FACW} + A_{FAC} + A_{FACU} + A_{UPL}}$$

where:
PI = Prevalence index
A_{OBL} = Summed percent cover values of obligate (OBL) plant species;
A_{FACW} = Summed percent cover values of facultative wetland (FACW) plant species;
A_{FAC} = Summed percent cover values of facultative (FAC) plant species;
A_{FACU} = Summed percent cover values of facultative upland (FACU) plant species;
A_{UPL} = Summed percent cover values of upland (UPL) plant species.

The prevalence index should range between 1 and 5. See Table 2-3 for an example calculation of the prevalence index using the same data set as in Table 2-2. The following web link provides free public-domain software for simultaneous calculation of the 50/20 rule and the prevalence index: http://www.crrel.usace.army.mil/rsgisc/wetshed/wetdatashed.htm.

Table 2-3
Example of the Prevalence Index using the same data as in Table 2-2.

Indicator Status Group	Species name	Percent Cover by Species	Total Cover by Group	Multiply by:[1]	Product
OBL species	None	0	0	1	0
FACW species	*Matteuccia struthiopteris* *Impatiens noli-tangere*	40 20	60	2	120
FAC species	*Ribes hudsonianum* *Calamagrostis canadensis* *Streptopus amplexifolius* *Salix alaxensis* *Alnus sinuata*	10 5 5 80 10	110	3	330
FACU species	*Equisetum arvense* *Thalictrum sparsiflorum* *Dryopteris dilatata* *Oplopanax horridus* *Populus balsamifera*[2]	10 10 5 5 20	50	4	200
UPL species	None	0	0	5	0
Sum			220 (A)		650 (B)
Hydrophytic Vegetation Determination		Prevalence Index = B/A = 650/220 = 2.95 Therefore, this community is hydrophytic by Indicator 2 (Prevalence Index).			

[1] Where OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5.
[2] *Populus balsamifera* was recorded in two strata (see Table 2-2) so the cover estimates for this species were summed across strata.

Indicator 3: Wetland cryptogams

Description: >50% of the total coverage of bryophytes consists of species known to be highly associated with wetlands (Table 2-1).

User Notes: The cryptogam indicator is based on the presence and abundance of a select group of wetland specialist bryophytes that were determined from paired wetland and nonwetland test sites in black spruce forests in Interior and Southcentral Alaska. The indicator may also be applicable in other subregions but has not been tested there. To satisfy this indicator, the summed cover value for wetland specialist bryophytes must be >50% of the total bryophyte cover in the plot. Follow this procedure:

1. Estimate total cover of bryophytes (mosses, liverworts, and hornworts) within a 1-meter-square plot. Lichens and fungi should not be included.

2. Estimate the cover value for each of the wetland specialist bryophytes (Table 2-1) present in the plot and sum their cover data.

3. Divide the summed cover value of wetland specialist bryophytes by the total bryophyte cover in the plot and multiply by 100 to convert to a percentage.

4. If >50% of the bryophyte layer consists of wetland specialists, then the vegetation is hydrophytic.

Indicator 4: Morphological adaptations

Description: The plant community passes either the dominance test (Indicator 1) or the prevalence index (Indicator 2) after reconsideration of the indicator status of certain plants that exhibit morphological adaptations for life in wetlands.

User Notes: Some hydrophytes in Alaska develop easily recognized physical characteristics, or morphological adaptations, when they occur in wetland areas. Some of these adaptations may help them to survive prolonged inundation or saturation in the root zone; others may simply be a consequence of living under such wet conditions. Common morphological adaptations in Alaska include, but are not limited to, adventitious roots (not to be confused with root systems above ground as the result of establishment on nurse logs), root systems much shallower than in upland areas, and aerenchyma tissue in herbaceous species. These adaptations may also develop on FACU and UPL species when they occur in wetlands, indicating that those individuals are capable of functioning as hydrophytes.

To apply this indicator, these morphological features must be observed on >50% of the individuals of a FACU or UPL species living in an area where indicators of hydric soil and wetland hydrology are present. Follow this procedure:

1. Confirm that the morphological feature is present mainly in the potential wetland area and is not also common on the same species in the surrounding uplands.

2. For each FACU or UPL species that exhibits morphological adaptations, estimate the percentage of individuals that have the features. Record this percentage on the data form.

3. If >50% of the individuals of a FACU or UPL species have morphological adaptations for life in wetlands, that species is considered to be a hydrophyte and its indicator status on that plot should be re-assigned as FAC. All other species retain their published indicator status. Record any supporting information on the data sheet, including a description of the morphological adaptation(s) present and any other observations of the growth habit of the species in adjacent wetland and upland locations (photo documentation is recommended).

4. Recalculate the dominance test (Indicator 1) and/or the prevalence index (Indicator 2) using a FAC indicator status for this species. The vegetation is hydrophytic if either test is satisfied.

3 – Hydric Soil Indicators

Introduction

The National Technical Committee for Hydric Soils (NTCHS) defines a hydric soil as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA Soil Conservation Service 1994). Nearly all hydric soils exhibit characteristic morphologies that result from repeated periods of saturation or inundation for more than a few days. Saturation or inundation, when combined with microbial activity in the soil, causes the depletion of oxygen. Anaerobiosis promotes certain biogeochemical processes, such as the accumulation of organic matter and the reduction, translocation, or accumulation of iron and other reducible elements. These processes result in characteristic morphologies that persist in the soil during both wet and dry periods, making them particularly useful for identifying hydric soils in the field.

This chapter presents indicators that are designed to help identify and delineate hydric soils in Alaska. This group of hydric soil indicators is a subset of the NTCHS *Field Indicators of Hydric Soils in the United States* (USDA Natural Resources Conservation Service, in press) that are commonly found in Alaska. A change to an indicator by the NTCHS represents a change to this subset of indicators for Alaska. This list of indicators is dynamic; changes and additions are anticipated with new research and field testing. To use the indicators properly, a basic knowledge of soil/landscape relationships and soil survey procedures is necessary. Furthermore, indicators are not intended to replace or relieve the requirements contained in the definition of a hydric soil given above.

Hydric soil indicators may be applicable statewide or they may be specific to certain subregions. As used in this supplement, subregions are equivalent to the Land Resource Regions (LRR) in Alaska recognized by the USDA Natural Resources Conservation Service (2004) with the exception that the Southern Alaska LRR has been split into Southcentral and Southeast subregions (see Chapter 1). It is important to note that boundaries between subregions are actually broad transition zones. Although an indicator may be noted as most relevant in a specific subregion, it may also be applicable in adjacent subregions.

The indicators are used to help identify the hydric soil component of wetlands; however, some hydric soils do not have any of the currently listed indicators. The absence of any listed indicator does not preclude the soil from being hydric. Guidance for identifying hydric soils that lack indicators is given in Chapter 5 (Difficult Wetland Situations in Alaska).

Notes on Alaska Soils

Organic Matter Accumulation

Saturated or inundated soils. Since the efficiency of soil microbes is considerably lower in an anaerobic environment, less organic matter and organic carbon is consumed by the microbes. Organic matter and carbon begin to accumulate. The result is the development of thick organic surfaces on the soil (Figure 3-1) or dark organic-rich surface mineral layers.

Figure 3-1. A saturated organic soil. In this profile, saturated organic material extends from the soil surface to a depth below 24 inches (60 cm).

Non-saturated or non-inundated soils. Cool temperatures and acid conditions result in the slow decomposition of organic matter. Many well-drained soils in Alaska, under aerobic conditions, have thick organic surface layers. These layers are not an indication of diminished microbial activity in a saturated anaerobic environment. The key difference is that these organic layers are not saturated for significant periods during the growing season.

Iron Reduction, Translocation, and Accumulation

Saturated or inundated soils. In an anaerobic environment, soil microbes reduce ferric iron (Fe^{+3}) to ferrous iron (Fe^{+2}). Areas in the soil where iron is reduced develop characteristic bluish-gray or greenish-gray colors known as *gley*. Ferric iron is insoluble but ferrous iron easily enters the soil solution. Iron that is reduced in some areas of the soil enters into the soil solution and is moved or translocated to other areas of the soil. Areas that have lost iron develop characteristic whitish-gray or reddish-gray colors and are known as *iron depletions*. If a soil reverts to an aerobic state, iron that is in solution will oxidize and become concentrated in patches and along pores and root channels. These areas of oxidized iron are called *redox concentrations*. Since water movement in these saturated or inundated soils can be multi-directional, iron depletions and redox concentrations can occur anywhere in the soil (Figure 3-2). Zones that are iron-depleted due to saturation and reduction normally occur as irregularly shaped or discontinuous patches and zones. Redox concentrations occur either as discontinuous patches or along root channels and pores.

Non-saturated or non-inundated soils. In well-drained, aerated soils, iron translocation is a normal process. Infiltration moves downward through the soil and together with the presence of organic acids, leaches or washes iron from mineral layers near the top of the soil. The iron moves in solution downward and accumulates in lower layers. As the near-surface layers are continually leached, their colors become similar to that of iron depletions. The accumulation of iron in the lower horizons may often result in colors similar to redox concentrations. This coloration is most pronounced in Spodosols.

Spodosols (Figure 3-3) form in relatively acidic soil material. They are most common in forested areas or upper mountain slopes in Southern Alaska. Organic carbon, iron, and aluminum are leached from a layer near the soil surface. This layer, known as the E horizon, has a bleached light gray appearance and consists of relatively clean particles of sand and silt. The materials leached from the E horizon are deposited lower in the soil in the Spodic horizon (Bhs or Bs horizon). If sufficient iron has been leached and redeposited, the spodic horizon will have a strong reddish color. Both E horizon and spodic horizon colors may be confused with the iron depletions and redox concentrations that result from anaerobic soil conditions.

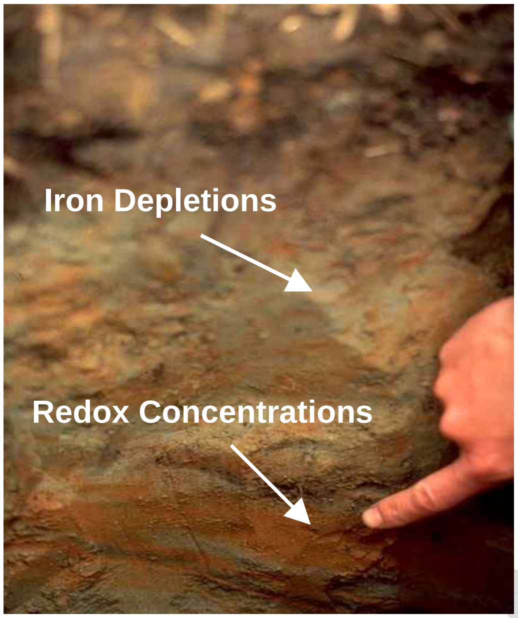

Figure 3-2. Iron depletions and redox concentrations in a hydric soil.

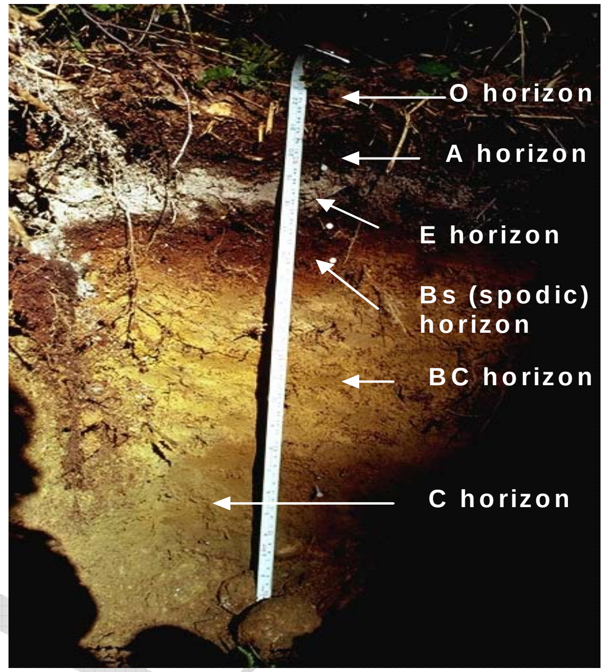

Figure 3-3. Example of a non-hydric Spodosol.

Normally, E horizon and spodic horizon material are present in the soil in relatively continuous horizontal bands (Figure 3-3). Chemical weathering in an aerated soil is accomplished by the downward movement of water; therefore, the layers or horizons are relatively parallel to the soil surface and consistent across the soil. Transitions are relatively abrupt between the organic surface, the leached E horizon, and the iron-enriched B horizon. Below the B horizon, the transition becomes more gradual with the red hue of the iron-enriched B horizon gradually changing to the yellower hue of the underlying C horizon.

If E horizons are thin or there are extensive plant roots, however, they may be discontinuous. Tree throw and cryoturbation can also mix and break the horizons of these aerated upland soils (Figure 3-4), so care should be taken to examine all site characteristics before concluding that a soil is hydric.

Figure 3-4. A well-drained Spodosol with strong E and Bh or spodic horizons. Horizons have been broken and mixed by tree throw. Care is needed not to confuse these with iron depletions and redox concentrations caused by soil saturation and anaerobiosis.

Confusing Redox Concentrations

Some soils have obvious redox concentrations but the site has little or no evidence of wetland hydrology or vegetation. These include the following situations:

Seasonal-frost affected soils. Seasonal frost is prevalent in areas with little snow cover or where wind commonly removes the snow cover. The seasonal frost forms a nearly impermeable layer similar to permafrost. During breakup, melt water perches on the seasonal frost layer, often resulting in near-surface saturation or ponding. The seasonal frost then degrades within one to two weeks and the soil's normal permeability resumes. The saturated conditions often result in redoximorphic features in the soil (Figure 3-5). True gley colors rapidly change to non-gley hues once oxidation is present, although redox concentrations remain.

Many of these soils are hydric, although they occur on landscape positions that are normally considered to be well-drained uplands. It is critical to observe carefully and note all other site characteristics, including indicators of hydrophytic vegetation and wetland hydrology, before classifying the area as either wetland or non-wetland.

Thawed permafrost-affected soils. In most soils affected by permafrost, the permafrost forms a restrictive layer that will perch water. In many such soils, the active layer above the permafrost table is saturated long enough during the growing season so that reduced conditions occur. Redoximorphic features and hydric soil indicators are often present (Figure 3-6).

Figure 3-5. Redox concentrations formed as a result of melt water perching on seasonal frost.

Figure 3-6. Thawed permafrost-affected soil. Redox concentrations remain 25 years after drainage improved.

If a natural or cultural activity, such as wildfire or land clearing, disturbs the surface organic layer, the temperature of a permafrost-affected soil may increase. This increase can result in enough thawing that the restrictive permafrost layer is either lowered in the soil profile or completely removed. If the soil occurs in an upland position and has no other restrictive layers, drainage can improve significantly. Similar to soils affected by seasonal frost, gley colors will alter to non-gley hues, but redox concentrations will persist. Therefore, hydric soil indicators may be present even though wetland hydrology has been lost. It is critical to observe carefully and note all other site characteristics, including vegetation and hydrology, before making the wetland determination.

Cautions

A soil that is artificially drained or protected (for instance, by levees) is hydric if the soil in its undisturbed state would meet the definition of a hydric soil. To be determined hydric, these soils should generally have one or more of the indicators.

Morphological features of hydric soils indicate that saturation and anaerobic conditions have existed under either contemporary or recent hydrologic conditions. Features that do not reflect contemporary or recent hydrologic conditions of saturation and anaerobiosis are relict features. Typically, contemporary and recent hydric soil features have diffuse boundaries; relict hydric soil features have abrupt boundaries. When soil morphology seems inconsistent with the landscape, vegetation, or observable hydrology, it may be necessary to obtain the assistance of an experienced soil or wetland scientist to determine whether soil features are relict.

Procedures for Sampling Soils

Observe and Document the Site

The common temptation is to excavate a small hole in the soil, note the presence of any indicators, make a decision, and leave. Before any decision can be made, however, the overall site and how it interacts with the soil must be understood. The following procedure can improve the accuracy of hydric soil and wetland decisions.

At each site, examine the following site features before looking for hydric soil indicators. Use all of the evidence available. If one or more of the listed soil indicators is present, the soil is hydric. Use the additional information about the site to understand why the soil is hydric. If no hydric soil indicators are present, use the additional site information to determine if the soil is indeed non-hydric or if it represents a 'problem' hydric soil.

- *Hydrology*–Is standing water observed on the site or is water observed in the soil pit? What is the water table depth in the area?

- *Slope*–Is the site level or nearly level so that surface water does not run off readily, or is it steeper where surface water would run off from the soil?

- *Slope shape*–Is the surface concave, where water would tend to collect and possibly pond on the soil surface? On hillsides, are there convergent slopes, where surface or groundwater may be directed toward a central stream or swale. Or is the surface or slope shape convex, causing water to run off or disperse?

- *Landform*–Is the soil on a low terrace or floodplain, which would be subject to seasonal high water tables or flooding? Is it at the toe of a slope where runoff may tend to collect or groundwater discharge at or near the surface?

- *Soil materials*–Is there a restrictive layer in the soil that would slow or prevent the infiltration of water? This could include permafrost, consolidated bedrock, a layer of silt, substantial clay content, or dense glacial till. Alternatively, is there relatively loose soil material (sand, gravel, or rocks) or fractured bedrock that would allow the soil to drain readily?

- *Vegetation*–Does the vegetation at the site indicate wetter conditions than at other nearby sites, or is it similar to that found on nearby upland sites?

The questions above should be considered at any site. Always look at the features of the immediate site and compare them to surrounding areas. Try to contrast the features of wet and dry sites that are in close proximity. When observing slope features, look first at the area immediately around the sampling point. A nearly level bench or depression at the immediate site may be more important to site wetness than the overall hillslope on which it occurs. Only by understanding the overall site can the investigator understand the presence or absence of indicators in the soil.

Observe and Document the Soil

To document a hydric soil, first remove all loose leaves, needles, or bark from the soil surface. Do not remove the organic surface layers of the soil, which usually consist of dead moss and other plant remains in varying stages of decomposition. Dig a hole and describe the soil profile to a depth of at least 20 inches (50 cm) from the soil surface. Use the completed soil profile description to determine which indicators have been matched.

Deeper examination of the soil may be required when field indicators are not easily seen within 20 inches (50 cm) of the surface. It is always recommended that soils be excavated and described as deep as necessary to make reliable interpretations. For example, examination to less than 20 inches (50 cm) may suffice in soils with surface horizons of saturated organic material or mucky mineral material. Conversely, the excavation depth will often need to be greater than 20 inches (50 cm) in soils with thick dark surface horizons because the upper horizons of these soils, due to the masking effect of organic material, often contain no easily visible redoximorphic features. At many sites, it is necessary to make exploratory observations to 40 inches (1 meter) or more. These observations should be made with the intent of documenting and understanding the variability in soil properties and hydrologic relationships on the site.

Whenever possible, excavate the soil deep enough to determine if there are layers or materials present that might restrict soil drainage. This will help to understand why the soil may or may not be hydric.

Depths used in the indicators are measured from the muck or mineral soil surface unless otherwise indicated. The majority of Alaska soils have an organic surface layer and it is important to distinguish between muck, and mucky peat or peat. Peat (fibric soil material), mucky peat (hemic soil material), and muck (sapric soil material) refer to the amount of decomposition of dead organic matter, with peat being the least decomposed, muck being the most decomposed, and mucky peat being intermediate. A simple field determination can be made by first removing or ignoring any living roots or other live plant materials and visually examining the soil layer in question. Muck will have almost no identifiable plant materials, while mucky peat and peat will contain easily recognizable plant materials such as leaves or stems. In addition, if the organic material is rubbed between the fingers ten times, muck produces a residue that is less than one-sixth fibers by volume. More technical descriptions of peat, mucky peat, and muck can be found in *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999).

All colors noted in this supplement refer to moist Munsell colors. Soil colors specified in the indicators do not have decimal points; however, intermediate colors do occur between Munsell chips. Soil chroma should not be rounded to qualify as meeting an indicator. For example, a soil matrix with a chroma between 2 and 3 should be listed as having a chroma of 2+. This soil material does not have a chroma of 2 and would not meet any indicator that requires a chroma of 2 or less.

Particular attention should be paid to changes in microtopography over short distances. Small changes in slope configuration may result in repetitive sequences of hydric/non-hydric soils, and the delineation of individual areas of hydric and non-hydric soils may be difficult. Often the dominant condition, either hydric or non-hydric, is the only reliable interpretation. The shape of the local landform can greatly affect the movement of water through the landscape. Significant changes in parent material or lithologic discontinuities in the soil can also affect the hydrologic properties of the soil. After a sufficient number of exploratory excavations have been made to understand the soil-hydrologic relationships at the site, subsequent excavations can be limited to the depth needed to identify hydric soil indicators.

Take photos of both the soil and the overall site. There may be no opportunity to return for more data.

Hydric Soil Indicators

Indicator A1: Histosol or Histel

Technical Description: Classifies as a Histosol (except Folist) or as a Histel (except Folistel).

Applicable Subregions: Applicable to all subregions in Alaska.

User Notes: Histosols are soils usually having 16 inches (40 cm) or more of saturated organic material measured down from the soil surface (Figure 3-7). Histels are simply Histosols that have permafrost in the soil profile, so some part of the organic material may be permanently frozen. Peak periods for observing saturation in each subregion are given below.

Excluded from the indicator are thick organic surfaces without evidence of saturation are excluded if not artificially drained (Folists and Folistels). Non-saturated organic surfaces are most likely to be found on convex topography or where organic debris has accumulated on the mineral soil surface.

Organic soil material includes peat (fibric), mucky peat (hemic), and muck (sapric) textures, and has an organic carbon content (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. See the glossary in USDA Natural Resources Conservation Service (2002) for definitions of muck, mucky peat, peat, and organic soil material. Evidence of saturation is the presence of a water table during at least part of the growing season. Saturation should be observable during peak periods within each subregion (see below) or may be inferred from wetland hydrology indicators outside of the peak period. Thin mineral strata may be observed within the organic layers and mineral material may be observed under the organic material. In some locations, ash deposits may overlie the organic material. The organic material in these soils consists primarily of mosses and other plant remains in varying stages of decomposition. Usually the plant remains are not identifiable and can be easily broken down by rubbing them between the fingers. These soils may or may not contain permafrost.

Aleutian Alaska. Saturation is likely to be observed throughout the year. Saturated organic deposits commonly occur in depressions and flats.

Interior Alaska. Saturation is most likely during May and late July-September. Saturated organic deposits commonly occur in groundwater discharge zones in depressions and lats and extensively across backslopes where restrictive layers (e.g., permafrost, glacial till) in the soil perch water.

Northern Alaska. Saturation is most likely during June-August. Saturated organic deposits commonly occur in coastal plains, depressions, slopes on the foothills, and on floodplains (Figure 3-8) where restrictive layers (e.g., permafrost, glacial till) in the soil perch water.

Southcentral Alaska. Saturation is most likely to be observed during April-May and September-October. Saturated organic deposits commonly occur in groundwater discharge zones along toeslopes and footslopes where restrictive layers (e.g., glacial till) in the soil have perched water. Also occur in depressions and along tidal fringe.

Southeast Alaska. Saturation is most likely to be observed during April-May and September-October. Saturated organic deposits commonly occur in groundwater discharge zones and where restrictive layers (e.g., bedrock, glacial till) in the soil have perched water.

Western Alaska. Saturation is most likely during May-September. Saturated organic deposits commonly occur in groundwater discharge zones in depressions and flats, and extensively across backslopes where restrictive layers (e.g., permafrost, glacial till) in the soil have perched water.

Figure 3-7. Example of a Histosol. This soil has saturated organic materials extending from the soil surface to a depth of more than 24 inches (60 cm).

Figure 3-8. Soils with thick, saturated organic surfaces normally occur in concave or plain landform positions. Areas may range in size from very small depressions on backslopes to large fens and bogs. Usually a restrictive layer, such as glacial till or permafrost, impedes the downward movement of water.

Indicator A2: Histic Epipedon

Technical Description: A histic epipedon.

Applicable Subregions: Applicable to all subregions in Alaska.

User Notes: Organic surfaces without evidence of saturation are excluded if not artificially drained. Non-saturated organic surfaces are most likely to be found on convex topography or where organic debris has accumulated on the mineral soil surface. Most histic epipedons are surface horizons 8 inches (20 cm) or more thick of organic soil material (Figure 3-9). Organic soil material includes peat (fibric), mucky peat (hemic), and muck (sapric) textures, and has an organic carbon content (by weight) of 12 to 18 percent or more, depending on the clay content of the soil. See the glossary in USDA Natural Resources Conservation Service (2002) for definitions of muck, mucky peat, peat, and organic soil material. Evidence of saturation is the presence of a water table during at least part of the growing season. Saturation should be observable during peak periods within each subregion (see Indicator A1) or may be inferred from wetland hydrology indicators outside of the peak period. Thin mineral strata may be observed within the organic layers and mineral material may be observed under the organic material. In some locations, ash deposits may overlie the organic material. The organic material in these soils consists primarily of mosses and other plant remains in varying stages of decomposition. Usually the plant remains are not identifiable and can be easily broken down by rubbing them between the fingers. These soils may or may not contain permafrost.

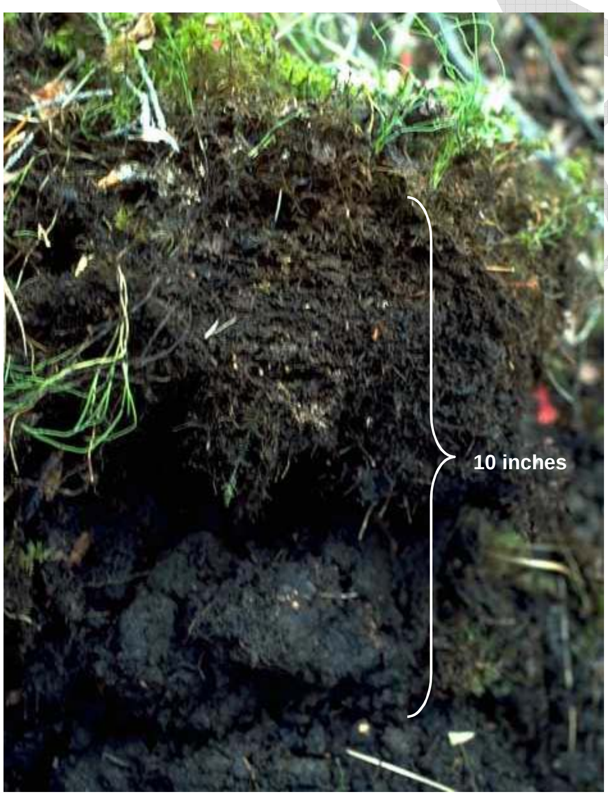

Figure 3-9. A histic epipedon consisting of saturated organic material overlying mineral soil. The saturated organic material extends from the soil surface to a depth of approximately 10 inches (25 cm).

Indicator A4: Hydrogen Sulfide

Technical Description: A hydrogen sulfide odor within 12 inches (30 cm) of the soil surface.

Applicable Subregions: Applicable to all subregions in Alaska.

User Notes: These soils are usually permanently saturated and anaerobic at or near the surface. Any time the excavated soil smells of hydrogen sulfide (rotten egg odor), sulfur is currently being reduced and the soil is definitely in an anaerobic state. In some soils, the odor is well pronounced; in others, it is very fleeting and the gas rapidly dissipates. If in doubt, quickly open several small holes in the area of concern to determine if a hydrogen sulfide odor is present.

Indicator A12: Thick Dark Surface

Technical Description: A mineral layer at least 6 inches (15 cm) thick with a depleted matrix that has 60 percent or more chroma 2 or less (or a gleyed matrix) starting below 12 inches (30 cm) of the surface. The layer(s) above the depleted or gleyed matrix have value 2.5 or less to a depth of 12 inches (30 cm) and value 3 or less and chroma 1 or less in the remainder of the epipedon. If the epipedon is sandy, at least 70 percent of the visible soil particles must be covered, coated, or similarly masked with organic material.

Applicable Subregions: Applicable in all subregions in Alaska.

User Notes: This indicator is used for soils with thick very dark surface mineral horizons that mask reduction features (Figure 3-10). Visible evidence of gley may only be observable deeper in the soil. Look below 12 inches (30 cm) for evidence of a depleted or gleyed matrix. See Indicator A13, Alaska Gleyed, User Notes, for the definition of a gleyed matrix. A *depleted matrix* is defined as follows:

> The volume of a soil horizon or subhorizon from which iron has been removed or transformed by processes of reduction and translocation to create colors of low chroma and high value. A, E, and calcic horizons may have low chromas and high values and may therefore be mistaken for a depleted matrix. However, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. In some places the depleted matrix may change color upon exposure to air (reduced matrix); this phenomenon is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:
>
> - Matrix value 5 or more and chroma 1 with or without redox concentrations as soft masses and/or pore linings, or
> - Matrix value 6 or more and chroma 2 or 1 with or without redox concentrations as soft masses and/or pore linings, or
> - Matrix value 4 or 5 and chroma 2 and has 2 percent or more distinct or prominent redox concentrations as soft masses and/or pore linings, or
> - Matrix value 4 and chroma 1 and has 2 percent or more distinct or prominent redox concentrations as soft masses and/or pore linings (USDA Natural Resources Conservation Service, in press).

Common (2 to less than 20 percent) to many (20 percent or more) redox concentrations (USDA Natural Resources Conservation Service 2002) are required in soils with matrix colors of 4/1, 4/2, and 5/2 (Figure 3-11). Distinct and prominent are defined in the glossary of USDA Natural Resources Conservation Service (in press) and illustrated in Table 3-1. Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas 1992). Included within this concept of redox concentrations are iron/manganese bodies as soft masses with diffuse boundaries. The iron/manganese masses are 2 to 5 mm and have value 3 or less and chroma 3 or less; most commonly they are black. Iron/manganese masses should not be confused with concretions and nodules associated with plinthitic (USDA Natural Resources Conservation Service 1999) or relict concretions.

Since some soils with thick dark surfaces are Spodosols, extreme care must be taken not to confuse grayish colored E horizon material with depleted colors. In addition, glacial deposits or marine sediments underlie some Alaska soils. These parent materials have base colors that can easily be confused with gleyed colors. Look for redox concentrations along pores and root channels (Indicator A14, Alaska Redox) and/or gleyed root channels (Indicator A15, Alaska Gleyed Pores) below 12 inches (30 cm).

Accumulation of organic carbon in mineral soil layers results in dark colors. Thicker dark surfaces are common in depressional areas where moisture accumulates and plant growth is enhanced. The thicker dark surfaces do not necessarily indicate saturation. If saturation does occur, the thick dark surface may mask or hide evidence of reduction near the soil surface. Look for two things. One is evidence of a depleted or gleyed matrix below the dark surface material. The other is a source of saturation. This may include a restrictive layer that perches precipitation and snowmelt, a nearby spring or seep, or a snowfield that persists late into the summer (see Indicator TA5, Alaska Alpine Swales in Chapter 5). Use of this indicator requires close observation and an understanding of landform position and local sources of hydrology.

Aleutian Alaska. This indicator is not known to occur in the subregion.

Interior Alaska. Saturation is most likely to be observed during April-May and September-October. Common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables. This indicator does not occur in permafrost affected soils.

Northern Alaska. Saturation is most likely to be observed during June-August. Common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables.

Southcentral Alaska. Saturation is most likely to be observed during April-May and September-October. Common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables.

Southeast Alaska. Unknown, but may exist.

Western Alaska. Saturation is most likely to be observed during April-May and September-October. Common indicator on mountain slopes where restrictive layers in the soil perch seasonal water tables. This indicator does not occur in permafrost-affected soils.

Figure 3-10. A depleted matrix begins at approximately 35 inches (89 cm) below a dark surface mineral horizon.

Figure 3-11. Illustration of values and chromas that require 2 percent or more redox concentrations and those that do not, for hue 10YR, to meet the definition of a depleted matrix.

Table 3-1
Tabular key for contrast determination using Munsell notation

Hues are the same (Δ h = 0)		
Δ Value	**Δ Chroma**	**Contrast**
0	≤1	Faint
0	2	Distinct
0	3	Distinct
0	≥4	Prominent
1	≤1	Faint
1	2	Distinct
1	3	Distinct
1	≥4	Prominent
≤2	≤1	Faint
≤2	2	Distinct
≤2	3	Distinct
≤2	≥4	Prominent
3	≤1	Distinct
3	2	Distinct
3	3	Distinct
3	≥4	Prominent
≥4	---	Prominent

Hues differ by 2 (Δ h = 2)		
Δ Value	**Δ Chroma**	**Contrast**
0	0	Faint
0	1	Distinct
0	≥2	Prominent
1	≤1	Distinct
1	≥2	Prominent
≥2	---	Prominent

Hues differ by 1 (Δ h = 1)		
Δ Value	**Δ Chroma**	**Contrast**
0	≤1	Faint
0	2	Distinct
0	≥3	Prominent
1	≤1	Faint
1	2	Distinct
1	≥3	Prominent
2	≤1	Distinct
2	2	Distinct
2	≥3	Prominent
≥3	---	Prominent

Hues differ by 3 or more (Δ h ≥ 3)		
Δ Value	**Δ Chroma**	**Contrast**
Color contrast is prominent, except for low chroma and value.		Prominent

Note: If both colors have values of ≤ 3 and chromas of ≤ 2, the color contrast is *Faint* (regardless of the difference in hue).
Adapted from USDA Natural Resources Conservation Service (2002).

Indicator A13: Alaska Gleyed

Technical Description: A mineral layer with a gleyed matrix that occupies 50 percent or more of a layer that starts within 12 inches (30 cm) of the soil surface. The gleyed matrix is underlain within 60 inches (1.5 m) of the soil surface by soil material with hue 5Y or redder that is the same type of parent material.

Applicable Subregions: Applicable to all subregions in Alaska.

User Notes: This indicator has two requirements. First, within 12 inches (30 cm) of the soil surface, a layer having one or more of the specified gleyed colors is present. A *gleyed matrix* has one of the following combinations of hue, value, and chroma and the soil is not glauconitic:

1. 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more and chroma 1; or
2. 5G with value 4 or more and chroma 1 or 2; or
3. N with value 4 or more (USDA Natural Resources Conservation Service, in press).

These colors can be found on the gleyed 1 and gleyed 2 pages of the Munsell color book (Gretag/Macbeth 2000) (Figure 3-12). Second, below these gleyed colors, the color of similar soil material is 5Y or redder (2.5Y, 10YR, 7.5YR, etc.). If the gley colors extend beyond a depth of 60 inches (1.5 m), the true color of the parent material cannot be determined. In that case, try applying Indicator A14 (Alaska Redox). The presence of gleyed colors indicates that the soil has undergone reduction. The requirement for 5Y or redder colors lower in the profile is to insure that the gleyed colors are not simply the basic color of the soil parent material. This indicator proves that the near-surface gleyed colors are not natural soil material colors, and that they are the result of reduced conditions. When comparing near-surface and underlying colors, make sure that the type of soil material is the same (Figure 3-13 and 3-14). Many soils in Alaska are composed of two or more types of material (e.g., silty loess overlying gravelly glacial till or sand and gravel river deposits). Tidal sediments, lacustrine sediments, loess, and some glacial tills have base colors that appear as gleyed. On closer examination, their colors will normally not fit on the gley color pages. Information specific to each subregion follows:

Aleutian Alaska. Commonly found in tidal flats and estuaries, and upland depressions. This indicator may be difficult to apply due to predominance of volcanic ash.

Interior Alaska. Commonly found along transition zones between fens and bogs and adjacent uplands, in groundwater discharge areas, and depressional areas within low floodplains. Saturation may be the result of a local riparian water table or water perched on restrictive layers, especially permafrost, within the soil.

Northern Alaska. Commonly found in depressions on floodplains, tidal flats, and foothills, and drainage channels on foothills. Saturation may be a result of local riparian water tables or water perched on permafrost.

Southcentral Alaska. Commonly found along transition zones between fens and bogs and adjacent uplands, groundwater discharge areas, and depressional areas within low floodplains. Saturation may be the result of a local riparian water table or water perched on restrictive layers within the soil.

Southeast Alaska. Commonly found along hill and mountain slopes. Saturation is usually the result of water perched on glacial till.

Western Alaska. Commonly found along transition zones between fens or bogs and the adjacent uplands, in groundwater discharge areas, and broad depressional areas within low floodplains and in deltaic areas. Saturation may be the result of a local riparian water table or water perched on restrictive layers, including permafrost, within the soil.

Figure 3-12. A gleyed matrix has the hues and chroma identified in this illustration with a value of 4 or more.

Figure 3-13. The bluish color of the soil material on the left (from the upper portion of the soil profile) indicates reduced conditions. The dark color of the soil material on the right (from lower in the same soil profile) is the color of the parent material and not the result of saturation.

Figure 3-14. The bluish band between 8 and 20 inches (20-50 cm) indicates the presence of reduced soil material. The underlying material below 8 inches reflects both the color of the parent material and soil weathering under aerobic conditions.

Indicator A14: Alaska Redox

Technical Description: A mineral layer that has dominant hue of 5Y with chroma of 3 or less, or hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB, with 10 percent or more distinct or prominent redox concentrations as pore linings with value and chroma of 4 or more. The layer starts within 12 inches (30 cm) of the soil surface.

Applicable Subregions: Applicable to all subregions in Alaska.

User Notes: Soils have a layer within 12 inches (30 cm) of the mineral surface that meets the specified color requirements. These colors can be found on the 5Y page or the gleyed 1 or gleyed 2 pages (Figure 3-12), (Gretag/Macbeth 2000). The layer must also contain at least 10 percent by volume redox concentrations (reddish orange iron coatings) along pores (Figure 3-15). Redox concentrations are required to prove that the gleyed colors are not parent material colors.

In soils that have been reduced, one of the first areas where oxygen will be re-introduced is along pores and the channels of live roots. As oxidation occurs in these areas, characteristic reddish-orange redox concentrations (value and chroma of 4 or more) will be apparent along the pores and linings. These will stand out in contrast to the matrix color of the overall soil layer.

When applying this indicator, first note the dominant color(s) of the soil layer to see if it matches the colors indicated. Then break open pieces of the soil and look for reddish-orange redox concentrations along pores and root linings (Figure 3-16 and Figure 3-17). If these conditions are met, it indicates the soil has been reduced during periods of wetness and, while in a drier state, has undergone oxidation.

Aleutian Alaska. Commonly found in tidal flats and upland depressions. Identification may be difficult due to the predominance of volcanic ash.

Interior Alaska. Commonly found on most landforms. Saturation may be the result of fluctuating water tables in riparian zones or fluctuating water tables perched on slowly permeable materials, especially permafrost.

Northern Alaska. Commonly found along foothills and micro-high positions (patterned ground) on coastal plains. Saturation is usually the result of a fluctuating water table perched on seasonal frost or permafrost.

Southcentral Alaska. Commonly found in depressions on most landforms. Saturation may be the result of fluctuating water tables in riparian zones or fluctuating water tables perched on slowly permeable sediments.

Southeast Alaska. Commonly found near uplifted beaches and estuaries with loamy glaciofluvial parent materials. Saturation is usually the result of a fluctuating water table perched on slowly permeable sediments.

Western Alaska. Commonly found on most landforms. Saturation may be the result of fluctuating water tables in riparian zones or fluctuating water tables perched on slowly permeable materials.

Figure 3-15. The matrix color meets the requirements of a gleyed matrix. Reddish orange redox concentrations occur along pores and channels of living roots.

Figure 3-16. Gleyed matrix colors and reddish-orange concentrations. Concentrations are along root channels.

Figure 3-17. Gleyed matrix color and redox concentrations surrounding root channels.

Indicator A15: Alaska Gleyed Pores

Technical Description: A mineral layer that has 10 percent or more hue N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value 4 or more in pores and along root channels starting within 12 inches (30 cm) of the soil surface. The matrix has a dominant hue of 5Y or redder.

Applicable Subregions: Applicable to all subregions in Alaska.

User Notes: This indicator is intended to look for subtle evidence of active reduction in a soil. Due to the presence of organic carbon along root channels, visible evidence of reduction will first occur along the root channels (Figure 3-18). The evidence is thin coatings meeting the specified color (hue, value) requirements. These colors can be found on the gleyed 1 and gleyed 2 pages (Gretag/Macbeth 2000) (Figure 3-12). Care must be taken to observe all of the color variations in the soil and not just the dominant soil color. Break pieces of soil open and closely look along the root channels. Many of these will be very thin or fine. Use of a hand lens may be helpful.

In a soil layer that is turning anaerobic, reduced conditions will first occur where the soil microbes have an ample supply of organic carbon. Colder soils, as in Alaska, normally have low organic carbon, so microbes will congregate along the channels containing dead roots. It is along these channels that gley colors will first appear.

Aleutian Alaska. Commonly found in tidal flats and upland depressions. This indicator may be difficult to apply due to predominance of volcanic ash.

Interior Alaska. Commonly found in riparian areas and in depressions on most landforms where water tables perch on slowly permeable sediments, primarily permafrost. Where water tables fluctuate, redox concentrations may also be present.

Northern Alaska. Commonly found along floodplains subject to fluctuating water tables and/or ponding.

Southcentral Alaska. Commonly found in riparian areas and in depressions on most landforms where water tables perch on slowly permeable sediments. Where water tables fluctuate, redox concentrations may also be present.

Southeast Alaska. May occur in any saturated mineral soil. May be found across all landforms.

Western Alaska. Commonly found in riparian areas and in depressions on most landforms where water tables perch on slowly permeable material. Where water tables fluctuate, redox concentrations may also be present.

Figure 3-18. Reduction occurs first along root channels where organic carbon is concentrated. Note gleyed colors along root channels.

Use of Existing Soil Data

Soil Surveys

Soil surveys are available for many areas of Alaska and can provide useful information regarding soil properties and soil moisture conditions for an area. Soil surveys in Alaska, however, vary considerably in the mapping scale and the amount of ground-truthing used to document the survey. A list of available soil surveys is located at http://www.ak.nrcs.usda.gov/technical/soils/soilsurveys.html. The most detailed surveys in the state are mapped at a scale of 1:24,000 (2.64 inches/mile). At this scale, the smallest soil areas delineated are about 5 acres in size. Map units do not contain only one soil type, but may have several inclusions of soils with similar properties and also soils that are quite dissimilar. Soils that are hydric are noted in the *Hydric Soils List* published as part of the survey report. The survey will provide information as to whether an area contains predominantly hydric or non-hydric soils, but it does not provide site-specific information. The soil survey provides valuable information but it does not preclude the need for on-site examination of a site. Several of the Alaska soil surveys are mapped at scales ranging from 1:63,360 to 1:250,000. Here the smallest areas delineated range anywhere from 25 to 100 acres in size. The surveys provide helpful information but cannot be used alone to make a hydric soil determination.

The *Exploratory Soil Survey of Alaska* provides coverage of the entire state at a scale of 1:1,000,000. The minimum size of areas delineated ranges from thousands to tens of thousands of acres. The *Exploratory Soil Survey of Alaska* provides a good overview of the major soil types in the various regions of the state. It does not provide any information for hydric soil determinations. The *Exploratory Soil Survey of Alaska* should not be used for identifying hydric soils.

Hydric Soils Lists

Hydric soils lists are developed for each of the “detailed” or 1:24,000 scale soil surveys in Alaska. Using criteria approved by the National Technical Committee for Hydric Soils, these lists rate each soil component as either hydric or non-hydric based on soil property data. If the soil is rated as hydric, information is provided regarding which hydric criterion is met and on what landform the soil typically occurs. Hydric soil lists are very useful. Remember, however, that these soil surveys only separate out different soil areas down to about five acres in size.

The hydric soil lists available for individual 1:24,000 scale soil surveys are known as *Local Hydric Soil Lists.* They are available as part of the published report for each survey area. Local Hydric Soils Lists have been compiled into a *National Hydric Soils List.* Use of the Local Hydric Soils Lists is preferred since it they are more current and reflect local variations in soil properties.

4 – Wetland Hydrology Indicators

Introduction

Wetland hydrology indicators are used in combination with indicators of hydric soil and hydrophytic vegetation to determine whether an area is a wetland under the Corps Manual. Soils and vegetation generally reflect a site's long-term to medium-term wetness history. The function of wetland hydrology indicators is to provide evidence that the site has a *continuing* wetland hydrologic regime and that hydric soils and hydrophytic vegetation are not relicts of a past hydrologic regime. Therefore, to the extent possible, wetland hydrology indicators are evidence of ongoing or recent flooding, ponding, or soil saturation or provide other evidence that hydric soils and hydrophytic vegetation reflect contemporary site conditions.

Hydrology indicators are the most ephemeral of wetland indicators. Those involving direct observation of surface water or saturated soils are often present only during the normal wet portion of the growing season and may be absent during the dry season or during drier-than-normal years. On the other hand, some indicators may be present on nonwetland sites immediately after a heavy rain, or during a period of unusually high precipitation, river stages, runoff, or snowmelt. Normal seasonal variations in rainfall, temperature, and other climatic conditions should always be considered in interpreting hydrology indicators. Hydrology indicators help to confirm the presence of a continuing wetland hydrologic regime; however, the lack of an indicator is not evidence for the absence of wetland hydrology. Wetland situations that may lack hydrology indicators are discussed further in Chapter 5 (Difficult Wetland Situations in Alaska).

Areas that have hydrophytic vegetation and hydric soils generally also have wetland hydrology, unless the hydrologic regime has changed due to natural events or human activities. Therefore, when wetland hydrology indicators are absent from an area that has hydric soils and hydrophytic vegetation, additional effort may be needed to determine whether wetland hydrology is present. If the original site visit was made during the dry season or a drier-than-normal year, it may be necessary to revisit the site during the wet season or in a normal year and check again for hydrology indicators. Analytical techniques involving stream gauge data, runoff estimates, remote sensing, scope-and-effect equations for ditches and subsurface drain lines, or groundwater modeling may also be useful (e.g., USDA Natural Resources Conservation Service 1997). On highly disturbed or problematic sites, direct hydrologic monitoring may be needed to determine whether wetland hydrology is present (U. S. Army Corps of Engineers 2005, in press). See Chapter 5 for additional guidance.

Wetland Hydrology Indicators

In this chapter, wetland hydrology indicators are presented in four groups. Indicators in Group A are based on the direct observation of surface water or groundwater during a site visit. Group B consists of indirect evidence that the site was flooded or ponded recently, although the site may not be inundated currently. These indicators include water marks, drift deposits, sediment deposits, and similar features. Group C consists of indirect evidence that the soil was saturated recently. Some of these indicators, such as oxidized rhizospheres surrounding living roots or the presence of reduced iron in the profile, indicate that the soil has been saturated for an extended period. Group D consists of landscape characteristics and vegetation and soil features that indicate contemporary rather than historical wet conditions. Wetland hydrology indicators are intended as one-time observations of site conditions that provide support for wetland determinations in areas where hydric soils and hydrophytic vegetation are present.

Within each group, indicators are divided into two categories – *primary* and *secondary* – based on their estimated reliability in the region. One primary indicator from any group is sufficient to conclude that wetland hydrology is present; the area is a wetland if indicators of hydric soil and hydrophytic vegetation are also present. In the absence of a primary indicator, two or more secondary indicators from any group are required to conclude that wetland hydrology is present. Indicators of wetland hydrology include, but are not necessarily limited to, those listed in Table 4-1 and described on the following pages. Other evidence of wetland hydrology may also be used with appropriate documentation.

Table 4-1. List of wetland hydrology indicators for Alaska[1]		
Indicator	**Category**	
	Primary	**Secondary**
Group A – Observation of Surface Water or Saturated Soils		
A1 – Surface water	X	
A2 – High water table	X	
A3 – Saturation	X	
Group B – Evidence of Recent Inundation		
B1 – Water marks	X	
B2 – Sediment deposits	X	
B3 – Drift deposits	X	
B4 – Mat or crust of algae or marl	X	
B5 – Iron deposits	X	
B6 – Surface soil cracks	X	
B7 – Inundation visible on aerial imagery	X	
B8 – Water-stained leaves		X
B9 – Drainage patterns		X
Group C – Evidence of Recent Soil Saturation		
C1 – Hydrogen sulfide odor	X	
C2 – Oxidized rhizospheres along living roots	X	
C3 – Dry-season water table	X	
C4 – Presence of reduced iron		X
C5 – Salt deposits		X
Group D – Evidence from Other Site Conditions or Data		
D1 – Unvegetated concave surface	X	
D2 – Stunted or stressed plants		X
D3 – Geomorphic position		X
D4 – Shallow aquitard		X
D5 – Plant morphological adaptations		X
D6 – Microtopographic relief		X
[1]Some indicators may be restricted to certain subregions (see text).		

Group A – Observation of Surface Water or Saturated Soils

Indicator: A1 – Surface water

Category: Primary

General Description: This indicator consists of the direct, visual observation of surface water (flooding or ponding) during a site visit (Figure 4-1).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Care must be used in applying this indicator because surface water may be present on a nonwetland site immediately after a rainfall event or during periods of abnormally high precipitation, runoff, tides, or river stages. Surface water observed during the nongrowing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season. Surface water may be absent from a wetland during the normal dry season or during periods of drought. Even under normal rainfall conditions, wetlands may have surface water present only one year in two (i.e., ≥50% probability). In addition, inundation may be infrequent, brief, or entirely lacking in groundwater-dominated wetland systems.

Figure 4-1. Wetland with surface water present.

Indicator: A2 – High water table

Category: Primary

General Description: This indicator consists of the direct, visual observation of the water table ≤12 inches (30 cm) of the surface in a soil pit, auger hole, or shallow monitoring well (Figure 4-2).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Sufficient time must be allowed for water to drain into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. Care must be used in interpreting this indicator because water-table levels normally vary seasonally and are a function of both recent and long-term precipitation. Even under normal rainfall conditions, wetlands may have water tables within 12 inches of the surface only one year in two (i.e., ≥50% probability). For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface.

Figure 4-2. High water table observed in a soil pit.

Indicator: A3 – Saturation

Category: Primary

General Description: Visual observation of saturated or near-saturated soil conditions as indicated by water glistening on the surfaces and broken interior faces of soil samples removed from the pit or auger hole ≤12 inches (30 cm) of the soil surface (Figure 4-3). This indicator must be associated with an existing water table located immediately below the saturated zone.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Glistening is evidence of saturated or near-saturated conditions, indicating that the soil sample was taken either below the water table or within the capillary fringe above the water table. Recent rainfall events and the proximity of the water table at the time of sampling should be considered in applying and interpreting this indicator. Water observed in soil cracks or on ped faces does not meet this indicator unless ped interiors are also saturated.

Figure 4-3. Water glistens on the surface of a saturated soil sample.

Group B – Evidence of Recent Inundation

Indicator: B1 – Water marks

Category: Primary

General Description: Water marks are discolorations or stains on bark of woody vegetation, rocks, bridge pillars, buildings, fences, or other fixed objects as a result of inundation (Figure 4-4).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: When several water marks are present, the highest reflects the maximum extent of inundation. Water marks indicate a water-level elevation and can be extrapolated from nearby objects across lower elevation areas. Use caution with water marks that may have been caused by extreme or abnormal flooding events or by brief, temporary flooding during the spring breakup period.

Figure 4-4. Water marks on a boulder.

Indicator: B2 – Sediment deposits

Category: Primary

General Description: Sediment deposits are thin layers or coatings of fine mineral material (e.g., silt or clay) or organic matter, sometimes mixed with other plant detritus, remaining on plants and other objects after inundation and dewatering (Figure 4-5).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Sediment deposits may remain for a considerable period before being removed by precipitation or subsequent inundation. Sediment deposits on vegetation or other objects indicate the minimum inundation level. This level can be extrapolated across lower elevation areas. This indicator does not include thick accumulations of sand or gravel in or adjacent to fluvial channels that may reflect historic flow conditions or recent extreme events. Use caution with sediment that may be left following spring snowmelt when silt and other material trapped in the snowpack is deposited directly on the ground surface.

Figure 4-5. Deposits of gray sediment on sedges in a tidal channel.

Indicator: B3 – Drift deposits

Category: Primary

General Description: Drift deposits consist of rafted debris that has been deposited on the ground surface or entangled in vegetation or other fixed objects. Debris consists of remnants of vegetation (e.g., branches, stems, and leaves), man-made litter, or other waterborne materials. Drift material may be deposited at or near the high water line in ponded or flooded areas, piled against the upstream side of trees, rocks, and other fixed objects, or widely distributed within the inundated and dewatered area (Figure 4-6).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Deposits of drift material are often found adjacent to streams or other sources of flowing water in wetlands. They also occur in tidal marshes, along lake shores, and in other ponded areas. Drift lines indicate the minimum water level attained during a flooding event; the maximum level of inundation is generally higher than that indicated by a drift line. The elevation of a drift line can be extrapolated across lower elevation areas. Use caution with drift lines that may have been caused by extreme, infrequent, or very brief flooding events.

Figure 4-6. Drift deposit of leaves in a seasonally ponded wetland.

Indicator: B4 – Mat or crust of algae or marl

Category: Primary

General Description: This indicator consists of a mat or dried crust of algae or marl, perhaps mixed with other detritus, left on or near the soil surface after dewatering.

Applicable Subregions: Applicable to all subregions in Alaska. Algal mats or crusts are not common but may be found throughout Alaska. Marl deposits are found mainly in Northern Alaska.

Cautions and User Notes: Algae or marl may be attached to low vegetation or other fixed objects, or may cover the soil surface. Dried surface crusts may crack and curl at plate margins (Figure 4-7). Algal crusts are usually seen in seasonally ponded areas, lake fringes, and low-gradient stream margins. They reflect prolonged wet conditions sufficient for algal growth and development. Marl deposits consist mainly of calcium carbonate precipitated from standing water through the action of algae or diatoms. Marl appears as a tan or whitish coating on the soil surface after dewatering (Figure 4-8).

Figure 4-7. Dried algal crust on the soil surface.

Figure 4-8. Marl deposit (tan-colored areas) and iron sheen in a subarctic fen.

Indicator: B5 – Iron deposits

Category: Primary

General Description: This indicator consists of a thin orange or yellow crust or gel of oxidized iron on the soil surface or on objects near the surface.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Iron deposits form in areas where reduced iron discharges with groundwater and oxidizes upon exposure to air. The oxidized iron forms a film or sheen on standing water (Figure 4-9) and an orange or yellow deposit (Figure 4-10) on the ground surface after dewatering.

Figure 4-9. Iron sheen on the water surface may be deposited as an orange or yellow crust after dewatering.

Figure 4-10. Iron deposit (orange area) in a ponded depression.

Indicator: B6 – Surface soil cracks

Category: Primary

General Description: Surface soil cracks consist of shallow cracks that form when mineral or organic soil material dries and shrinks, often creating a network of cracks or small polygons (Figures 4-11 and 4-12).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: This indicator is usually seen in fine sediments in seasonally ponded depressions, lake fringes, or floodplains. It should not be confused with patterned-ground features caused by frost action in Interior, Northern, and Western Alaska.

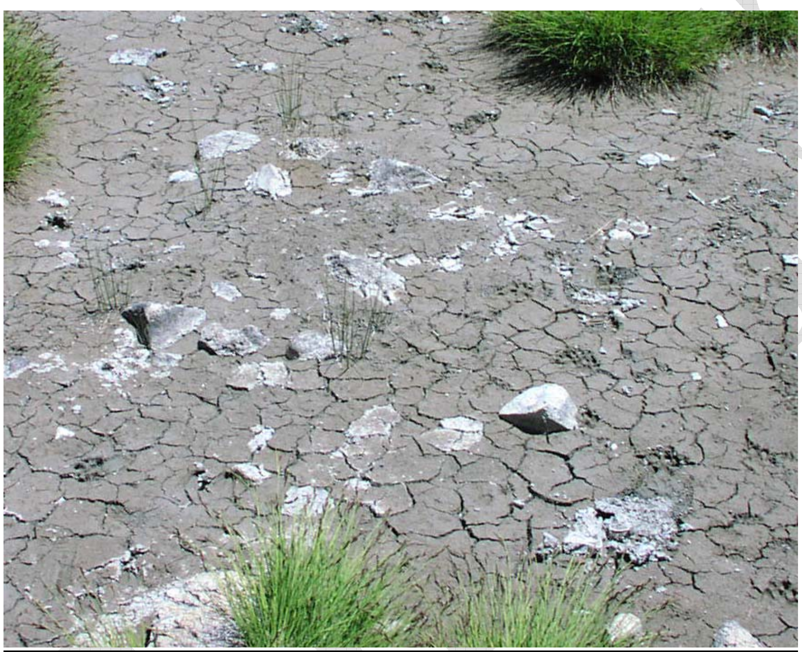

Figure 4-11. Surface cracks in a mineral soil in a seasonally ponded wetland.

Figure 4-12. Surface cracks in an organic soil.

Indicator: B7 – Inundation visible on aerial imagery

Category: Primary

General Description: One or more recent aerial photographs or satellite images show the site to be inundated.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: The most recent available aerial imagery should be used to evaluate this indicator. Older imagery may be useful if there has been no known hydrologic change. Care must be used in applying this indicator because surface water may be present on a nonwetland site immediately after a heavy rain or during periods of abnormally high precipitation, runoff, tides, or river stages. WETS tables provided by the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) may be used to determine whether rainfall prior to the photo date was normal, greater than normal, or less than normal based on long-term records at National Weather Service stations. Even under normal rainfall conditions, wetlands may have surface water present only one year in two (i.e., ≥50% probability). Surface water observed during the nongrowing season may be an acceptable indicator if experience and professional judgment suggest that wet conditions normally extend into the growing season. Surface water may be absent from a wetland during the normal dry season or during periods of drought. Normal seasonal and annual variations in water levels should be considered in interpreting this indicator.

Indicator: B8 – Water-stained leaves

Category: Secondary

General Description: Water-stained leaves are fallen leaves or needles that have turned dark grayish or blackish in color due to inundation for long periods.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Water-stained leaves are generally found in depressions, flats, or along stream margins in forested or shrub-dominated wetlands. Water-stained leaves maintain their blackish or dark grayish colors when dry. They should contrast strongly with fallen leaves in nearby upland landscape positions.

Indicator: B9 – Drainage patterns

Category: Secondary

General Description: This indicator consists of evidence that water flowed across the ground surface, such as flow patterns eroded into the soil, low vegetation bent over in the direction of flow, absence of leaf litter or small woody debris due to flowing water, and scouring of soil from around plant roots.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Drainage patterns are usually seen in areas where water flows broadly over the surface and is not confined to a channel, such as in areas adjacent to streams (Figure 4-13), slope wetlands, vegetated swales, and tidal flats. Use caution in areas affected by extreme or abnormal flooding events or by brief, temporary flooding during the spring breakup period.

Figure 4-13. Vegetation bent over in the direction of water flow across a stream terrace.

Group C – Evidence of Recent Soil Saturation

Indicator: C1 – Hydrogen sulfide odor

Category: Primary

General Description: A hydrogen sulfide (rotten egg) odor within 12 inches (30 cm) of the soil surface.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: To produce hydrogen sulfide, the soil must be saturated at the time of sampling and must have been saturated long enough to become highly reduced. These soils are often permanently saturated and anoxic at or near the surface. To apply this indicator, dig the soil pit no deeper than 12 inches to avoid release of hydrogen sulfide from deeper in the profile.

Indicator: C2 – Oxidized rhizospheres along living roots

Category: Primary

General Description: This indicator consists of iron oxide coatings or plaques on the surfaces of living roots and/or iron oxide coatings or linings on soil pores immediately surrounding living roots within 12 inches (30 cm) of the soil surface (Figure 4-14).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Iron oxide coatings are the result of oxygen leakage from living roots into the surrounding anoxic soil, causing oxidation of ferrous iron present in the soil solution. They are evidence of saturated and reduced soil conditions during the plant's lifetime. Iron concentrations or plaques may form on the immediate root surface or may coat the soil pore adjacent to the root. In either case, the oxidized iron must be associated with living roots to indicate contemporary wet conditions. Care must be taken to distinguish iron oxide coatings from organic matter associated with plant roots. Viewing with a hand lens may help distinguish mineral from organic material. Iron coatings sometimes show concentric layers in cross section and may transfer iron stains to the fingers when rubbed.

Figure 4-14. Iron oxide plaque (orange coating) on a living root. Iron oxide also coats the channel or pore from which the root was removed.

Indicator: C3 – Dry-season water table

Category: Primary

General Description: This indicator consists of the visual observation of the water table between 12–24 inches (30–60 cm) of the surface for mineral soils, or 12–40 inches (30–100 cm) for organic soils, during the normal dry season or during a drier-than-normal year.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Due to normal seasonal fluctuations, water tables in wetlands often drop below 12 inches during the dry season. For sites with mineral soils in Alaska, an observed water table within 24 inches during the dry season, or during an unusually dry year, is strong evidence for a water table within 12 inches during the normal wet portion of the growing season. For organic soils, a dry-season water table within 40 inches indicates a normal wet-season water table within 12 inches. A soil auger may be needed to evaluate this indicator. Sufficient time must be allowed for water to drain into a newly dug hole and to stabilize at the water-table level. The required time will vary depending upon soil texture. In some cases, the water table can be determined by examining the wall of the soil pit and identifying the upper level at which water is seeping into the pit. For an accurate determination of the water-table level, the soil pit, auger hole, or well should not penetrate any restrictive soil layer capable of perching water near the surface. See Chapter 5 (section on Wetlands that Periodically Lack Indicators of Wetland Hydrology) for average dry-season dates and procedures for evaluating normal rainfall and snowpack.

Indicator: C4 – Presence of reduced iron

Category: Secondary

General Description: Presence of reduced (ferrous) iron in the upper 12 inches (30 cm) of the soil profile, as indicated by a positive reaction to a ferrous iron test or by the presence of one of the following hydric soil indicators: Alaska Gleyed, Alaska Redox, Alaska Gleyed Pores, or Color Change.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: The reduction of iron occurs in soils that have been saturated long enough to become anoxic and chemically reduced. Thus, the presence of ferrous iron usually indicates that the soil is saturated at the time of sampling and has been saturated for an extended period of time (Figure 4-15). The presence of ferrous iron can be verified with alpha, alpha-dipyridyl dye (see Chapter 5) or through observation of certain soil features, such as gley colors, that reflect current iron reduction. The following hydric soil indicators are evidence that ferrous iron is present in the profile at the time of sampling: Alaska Gleyed, Alaska Redox, Alaska Gleyed Pores, and Color Change. Soil samples should be examined immediately after opening the soil pit because features may fade and disappear soon after the sample is exposed to the air.

Figure 4-15. Gleyed soil colors indicate that ferrous iron is present and the soil is currently saturated.

Indicator: C5 – Salt deposits

Category: Secondary

General Description: Salt deposits are whitish or brownish deposits of salts that accumulate on the ground surface through the capillary action of groundwater (Figure 4-16).

Applicable Subregions: Applicable to Interior Alaska and western portions of Southern Alaska, in areas of seasonal moisture deficit.

Cautions and User Notes: Salt deposits occur in areas of seasonal moisture deficit where evaporation brings capillary water to the surface. They often occur on floodplain terraces after surface water has receded and the water table is near the surface. Salt deposits in Alaska are not known to occur outside of Interior and Southern Alaska.

Figure 4-16. Salt deposits on the soil surface (25-cent coin for scale).

Group D – Evidence from Other Site Conditions or Data

Indicator: D1 – Unvegetated concave surface

Category: Primary

General Description: This indicator is found on concave land surfaces (depressions and swales) and consists of areas that are unvegetated or sparsely vegetated due to long-duration ponding during the growing season (Figure 4-17).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Unvegetated concave surfaces should contrast with vegetated slopes and convex surfaces in the same area. Use caution to avoid confusing this indicator with small bare areas resulting from patterned-ground processes in Northern, Interior, and Western Alaska.

Figure 4-17. An unvegetated, seasonally ponded depression.

Indicator: D2 – Stunted or stressed plants

Category: Secondary

General Description: This indicator is present if individuals of the same species growing in the potential wetland are clearly of smaller stature, less vigorous, or stressed compared with individuals growing in nearby nonwetland situations (Figure 4-18).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Some plant species in Alaska grow in both wetlands and uplands but may exhibit stunting or stress in wet situations (e.g., *Picea mariana*). Use caution in areas where stunting of plants on upland sites may be caused by low soil fertility, excessively drained soils, cold temperatures, or other factors. For this indicator to be present, a majority of individuals in the stand must be stunted or stressed.

Figure 4-18. Black spruce in the wetland (foreground) are stressed and stunted compared with spruce in the adjacent upland (background).

Indicator: D3 – Geomorphic position

Category: Secondary

General Description: This indicator is present if the area in question is located (1) in a localized depression or other concave surface, (2) within a minor drainage or on an active floodplain, or (3) on the low-elevation fringe of a pond, lake, estuary, or ocean (Figure 4-19).

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Excess water from precipitation and snowmelt naturally accumulates in certain geomorphic positions in the landscape, particularly in low-lying areas such as depressions, drainages, and fringes of water bodies. With the exceptions noted below, these areas in Alaska often exhibit wetland hydrology.

Exceptions: This indicator does not include depressional areas in karst topography in southeastern Alaska, which often drain freely. Furthermore, there are areas throughout Alaska where concave topography exists on rapidly permeable soils (e.g., outwash plains with sand and gravel substrates) that do not have wetland hydrology unless the water table is near the surface.

Figure 4-19. Certain geomorphic positions, such as lake fringes, are evidence of wetland hydrology.

Indicator: D4 – Shallow aquitard

Category: Secondary

General Description: This indicator consists of the presence of an aquitard within the upper 24 inches (60 cm) of the soil profile that is potentially capable of perching water within 12 inches (30 cm) of the surface.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: An aquitard is a relatively impermeable soil layer or bedrock that slows the downward percolation of water and can produce a perched water table. Potential aquitards include permafrost, dense glacial till, lacustrine deposits, iron-cemented layers, or clay layers. Soil layers that are only seasonally frozen do not qualify as aquitards unless they are observed to perch water for long periods during the growing season in most years.

Indicator: D5 – Plant morphological adaptations

Category: Secondary

General Description: Most individuals of one or more dominant plant species exhibit morphological adaptations for life in wetlands.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: Morphological adaptations include adventitious roots (Figure 4-20); swollen or buttressed bases on shrubs, saplings, or trees; shallow or exposed root systems; multiple trunks or woody stems; and aerenchyma. Care must be taken in applying this indicator because some morphological features (e.g., shallow roots, buttressed bases) may be caused by shallow bedrock or other factors. Use caution to distinguish adventitious roots due to wetness from splayed roots resulting from seedling establishment on nurse logs. In addition, some features may persist after the hydrology of a site has changed.

Figure 4-20. Adventitious roots on willows (*Salix* sp.).

Indicator: D6 – Microtopographic Relief

Category: Secondary

General Description: This indicator consists of the presence of microtopographic features, such as hummocks, flarks and strangs, tussocks, frost circles, or pedestals, with microhighs less than 36 inches (90 cm) above the base soil level.

Applicable Subregions: Applicable to all subregions in Alaska.

Cautions and User Notes: These features are the result of vegetative and geomorphic processes in wetlands and produce the characteristic microtopographic diversity in some systems (Figures 4-21 and 4-22). Microtopographic lows are either inundated or have shallow water tables for long periods each year. Microtopographic highs may or may not have wetland hydrology, but usually are small, narrow, or fragmented, often occupying less than half of the surface area. See Chapter 5 for further information on wetland-delineation procedures in hummocky terrain.

Figure 4-21. Aerial view of flarks (microlows and pools dominated by sedges) and strangs (low ridges) in a wetland complex near Anchorage.

Figure 4-22. Frost circles in Denali National Park. Light-colored areas are microhighs dominated by lichens. Microlows are dominated by dwarf birch (*Betula nana*) and sedges.

5 – Difficult Wetland Situations in Alaska

Introduction

Some wetlands can be difficult to identify because wetland indicators may be missing at times due to natural processes or recent disturbances. This chapter provides guidance for making wetland determinations in difficult-to-identify wetland situations in Alaska. It includes regional examples of Problem Area wetlands and Atypical Situations as defined in the Corps Manual, as well as other situations that can make wetland delineation more challenging. Problem Area wetlands are defined as naturally occurring wetland types that periodically lack indicators of hydrophytic vegetation, hydric soil, or wetland hydrology due to normal seasonal or annual variability. In addition, some Problem Area wetlands may permanently lack certain indicators due to the nature of the soils or plant species on the site. Atypical Situations are defined as wetlands in which vegetation, soil, or hydrology indicators are absent due to recent human activities or natural events. In addition, this chapter addresses certain procedural problems (e.g., wetland/non-wetland mosaics) that can make wetland determinations in Alaska difficult or confusing. The chapter is organized into the following sections:

1. Wetlands that lack indicators of hydrophytic vegetation
2. Problematic hydric soils
3. Wetlands that periodically lack indicators of wetland hydrology
4. Wetland/non-wetland mosaics

This list is not intended to be exhaustive and other problematic wetland situations may exist in the state. See the Corps Manual for general guidance. In general, *wetland determinations on difficult or problematic sites must be based on the best information available to the field inspector, interpreted in light of his or her personal experience and knowledge of the ecology of wetlands in the region.*

Wetlands that Lack Indicators of Hydrophytic Vegetation

Description of the Problem

Some wetlands in Alaska are difficult to identify because their plant communities are dominated mainly by FACU species, causing them to fail both the dominance test and prevalence index. Some of these communities may exhibit other indicators of hydrophytic vegetation (e.g., wetland cryptogams, morphological adaptations), but others may not. Examples of FACU species that may dominate in certain wetland situations include paper birch (*Betula papyrifera*), white spruce (*Picea glauca*), sitka spruce (*P. sitchensis*), devil's club (*Oplopanax horridus*), and field horsetail (*Equisetum arvense*). Sometimes these FACU species occur on hummocks, slightly elevated above the general soil level, where they can avoid the physiological effects of prolonged saturation in the root zone. Other FACU and UPL herbs and shrubs may co-occur with these species on hummocks. At other times, they may be more generally distributed across the wet area. Wetlands along creeks in the Anchorage basin, for example, are often dominated by *B. papyrifera* growing on hummocks with *E. arvense* growing more widely in the understory.

Procedure

Wetlands dominated by FACU or UPL species can be identified through a combination of observations made in the field and/or supplemental information from the scientific literature. This procedure should be applied only where indicators of hydric soil and wetland hydrology are present but no indicators of hydrophytic vegetation are evident. The following procedure is recommended:

1. Verify that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present. If indicators of either hydric soil or wetland hydrology are absent, the area is likely non-wetland. If the site has hummocks, be sure to evaluate soils and hydrology both on hummocks and in hollows. If indicators are present, proceed to step 2.

2. Use one or more of the following approaches to determine whether the site is a wetland:

    a. *Plants growing on hummocks.* In areas where hummocks have indicators of both hydric soils and wetland hydrology, FACU or UPL plant species occupying the hummocks are considered to be acting as hydrophytes. They should be treated as FAC when determining whether hydrophytic vegetation is present. If indicators of hydric soils or wetland hydrology, or both, are absent on the hummocks, see procedures for wetland/non-wetland mosaics described later in this chapter.

    b. *Direct hydrologic observations.* Verify that the plant community occurs in an area subject to prolonged inundation or soil saturation during the growing season. This can be done by visiting the site at 2-3 day intervals during the portion of the growing season when surface water is most likely to be present or water tables are normally high. Hydrophytic vegetation is considered to be present, and the site is a wetland, if there is surface water present and/or the soil is saturated within 12 inches of the surface for ≥14 consecutive days during the growing season. If necessary, microtopographic highs and lows should be evaluated separately. The normality of the previous winter's snowpack and current year's rainfall should be considered in interpreting field results, as well as the likelihood that wet conditions will occur on the site at least every other year (see the section on Wetlands that Periodically Lack Indicators of Wetland Hydrology later in this chapter).

    c. *Reference sites.* If indicators of hydric soil and wetland hydrology are present on a site with FACU and UPL dominated vegetation, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas. Wetland reference areas should have documented hydrology established through long-term monitoring or by repeated application of the procedure described in item *b* above. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the district or field office.

d. *Technical literature.* Published scientific literature, from both refereed and non-refereed sources, including reliable internet sources, may be used to support a decision to treat specific FACU or UPL species as hydrophytes or certain plant communities as hydrophytic. Preferably, this literature should discuss the species' natural distribution along the moisture gradient, its capabilities and adaptations for life in wetlands, wetland types in which it is typically found, or other wetland species with which it is commonly associated.

e. *Vigor and stress responses resulting from wetland conditions.* Plant responses to wet site conditions are commonly recognized. Crop stress in wet agricultural fields, for example, is easily identifiable both in the field and on aerial photographs. Many plants have observable stress-related features such as stunting, browning, or yellowing when growing under wet conditions. Black spruce, for instance, obtains larger size in well aerated soils and is often stunted when growing in wetlands. Also, many species show an increase in abundance or plant vigor when growing on wet sites. These responses are not necessarily species specific or easy to quantify. The following procedure is recommended to determine whether the increase or decrease in plant vigor or stress is a result of growing under wetland conditions.

   i. Compare the size, vigor, or stress features of the affected species between the potential wetland and immediately adjacent uplands.

   ii. Measure and describe on the data form or in field notes the changes observed in vigor/stress conditions along a gradient from wetland to upland that can be used to help determine the limits of the wetland.

   iii. If >50% of the individuals of any FACU or UPL species show increased vigor/stress in the potential wetland, they should be treated as FAC for the purposes of determining if hydrophytic vegetation is present.

   iv. The vegetation in the potential wetland should be re-evaluated using hydrophytic vegetation indicators 1 (Dominance Test) or 2 (Prevalence Index) to determine whether hydrophytic vegetation is present.

f. *Point-intercept sampling method.* Plot-based vegetation sampling can be difficult in communities that are highly diverse or have patchy or heterogeneous plant cover. This can create a problem for the wetland delineator, particularly in areas where the hydrophytic vegetation determination may be borderline. In these cases, it may be necessary to use a more accurate and repeatable assessment of cover. In point-intercept sampling, plant occurrence is determined at points located at fixed intervals along one or more transects established in random locations within the plant community. Usually a tape measure is laid on the ground and used for the transect line. Transect length depends upon the size and complexity of the plant community and may range from 100 to 300 ft (30 to 90 m) or more. Plant occurrence data are collected at fixed intervals along the line, for example every 2 ft (0.6 m). At each interval, a "hit" on a species is recorded if a vertical line at that point would intercept the stem or foliage of that species. Only one "hit" is recorded for a species at a point even if the same species would be intercepted more than once at that point. Vertical intercepts can be determined using a long pin or rod protruding into and through the various strata, a sighting device (e.g., for the canopy), or an imaginary vertical line. The total number of "hits" for each species along the transect is then determined. The result is a list of species and their frequencies of occurrence along the line (Mueller-Dombois and Ellenberg 1974, Tiner 1999). Species are then categorized by wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL) and the data used to calculate a prevalence index. The formula is similar to that given in Chapter 2, except that frequencies are used in place of cover estimates. The community is hydrophytic if the prevalence index is ≤3.0. To be valid, more than 80% of "hits" on the transect must be of species that have been identified correctly and placed in an indicator category.

Calculate the prevalence index using the following formula:

$$PI = \frac{F_{OBL} + 2F_{FACW} + 3F_{FAC} + 4F_{FACU} + 5F_{UPL}}{F_{OBL} + F_{FACW} + F_{FAC} + F_{FACU} + F_{UPL}}$$

where:
PI = Prevalence index
F_{OBL} = Frequency of obligate (OBL) plant species;
F_{FACW} = Frequency of facultative wetland (FACW) plant species;
F_{FAC} = Frequency of facultative (FAC) plant species;
F_{FACU} = Frequency of facultative upland (FACU) plant species;
F_{UPL} = Frequency of upland (UPL) plant species.

Problematic Hydric Soils

Introduction

Some soils that meet the hydric soil definition may not exhibit any of the indicators presented in Chapter 3. These problematic hydric soils exist for a number of reasons and require additional information, such as landscape position, presence or absence of restrictive soil layers, or information about hydrology, to identify properly. This section describes several soil situations in Alaska that are considered hydric if additional requirements are met. In some cases, these hydric soils may appear non-hydric due to the color of the parent material from which the soils developed. In others, the lack of hydric soil indicators is due to conditions that inhibit the development of redoximorphic features despite prolonged soil saturation and anoxia. In addition, recently developed wetlands may lack hydric soil indicators because insufficient time has passed for their development. Examples of problematic hydric soils in Alaska include, but are not limited to, the following.

Soils with low organic-carbon content. Soil microbes require the presence of sufficient organic carbon in a soil in order to thrive. If there is little or no organic carbon present in a saturated soil, microbial activity will often be insufficient to produce noticeable hydric soil indicators. This is especially true in young or recently formed soils. Examples include recently formed sandy and gravelly soils (Figure 5-1).

Soils with low weatherable-iron content. A soil may contain little or no weatherable iron-bearing material due to the mineralogy of the parent material in which it formed. Gley colors, iron depletions, redox concentrations, and reaction to alpha-alpha-dipyridyl dye all require the presence of weatherable iron. If sufficient weatherable iron-bearing material is lacking in a saturated soil, these hydric soil indicators will be very weak or absent. Examples include soils formed in some types of volcanic ash or from diorite parent materials.

Soils with high pH. Formation of redox concentrations and depletions require that soluble iron be present in the soil. Iron readily enters into solution in acidic soils. In soils with higher pH, less iron enters into solution. As a result, redox concentrations may be very faint and difficult to observe in a soil with higher pH (Figure 5-2). Examples include soils in the Copper River Basin that have high pH due to the influence of parent material.

Recently developed wetlands. Recently developed wetlands include mitigation sites, wetland management areas (e.g., for waterfowl), other wetlands intentionally or unintentionally produced by human activities, and naturally occurring wetlands that have not been in place long enough to develop hydric soil indicators. These soils should be considered hydric if they are ponded, flooded, or saturated for ≥14 consecutive days during the growing season in most years based on actual data and not on estimated soil properties.

Figure 5-1. Low organic-matter content and coarse gravelly materials can make identification of hydric soil indicators difficult.

Figure 5-2. Gley colors and redox concentrations are relatively faint due to the high pH of the soil materials in this profile from the Copper River Basin.

Soils that do not meet the Alaska Redox indicator only because they have a hue of 2.5Y. Hue of 2.5Y is excluded from the Alaska Redox indicator (A14). This is to avoid confusion with non-hydric soils that have hue of 2.5Y resulting from the color of the parent material and contain relict redox concentrations. Examples include soils formed in glacial tills and loess, especially if they were affected by seasonal frost or permafrost in the past. There are, however, areas where a hue of 2.5Y, low chroma (chroma 3 or less), and presence of redox concentrations do indicate a hydric soil. Such soils are often found on the fringes of wetlands as they transition to upland areas.

Soils that do not meet the Alaska Gleyed indicator only because they are not underlain by a layer with hue of 5Y or redder. The Alaska Gleyed indicator (A13) requires that the gleyed zone be underlain by similar soil material having a hue of 5Y or redder. This requirement is intended to eliminate confusion with non-hydric soils that have parent material colors similar to gleyed colors. There are, however, areas where continuously saturated conditions result in gleyed colors that are present to considerable depths in the soil profile. Such soils are continuously reduced and lack redox concentrations.

Soils that change color upon exposure to the air. This situation is described by the USDA Natural Resources Conservation Service (in press) in test indicator TA4 (Alaska Color Change) as follows:

Technical Description: A mineral layer 4 inches (10 cm) or more thick starting within 12 inches (30 cm) of the soil surface that has a matrix value of 4 or more and chroma of 2 or less that becomes redder by one or more in hue and/or increases one or more in chroma when exposed to air within 30 minutes.

Applicable Subregion: Applicable to all subregions in Alaska.

User Notes: This indicator may be observed in some mineral soils that are currently at or near saturation. If the soil matrix is sufficiently reduced and has gley colors, reduced iron (Fe^{+2}) in the soil can begin to oxidize into Fe^{+3} upon exposure to the air (Figures 5-3 and 5-4). If the soil contains sufficient iron, this can result in an observable color change, especially in hue or chroma.

Care must be taken to obtain an accurate color of the soil sample immediately upon excavation. The colors should observed closely and examined again after several minutes. Do not allow the sample to begin drying, as drying will also result in a color change. As always, do not obtain colors while wearing sunglasses. Colors must be obtained in the field under natural light and not under artificial light.

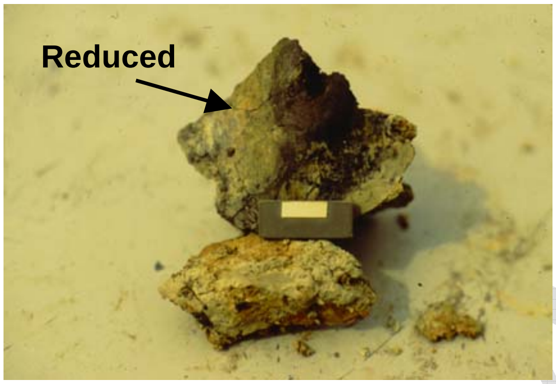

Figure 5-3. This soil exhibits colors associated with reducing conditions. Scale is 1 cm.

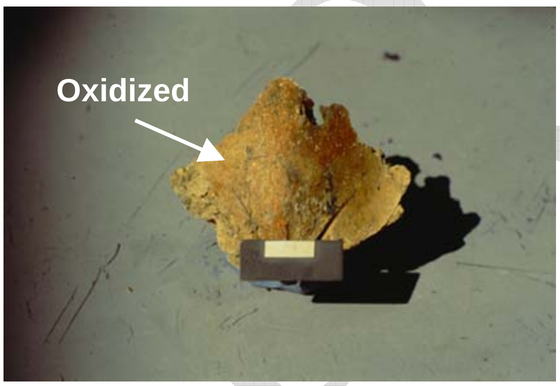

Figure 5-4. The same soil as in Figure 5-3 after exposure to the air and oxidation has occurred.

Soils of alpine swales. This situation is described by the USDA Natural Resources Conservation Service (in press) in test indicator TA5 (Alaska Alpine Swales) as follows:

Technical Description: On concave landforms in alpine and subalpine areas, the presence of a surface mineral layer at least 4 inches (10 cm) or more thick having hue of 10YR or yellower, value 2.5 or less, and chroma 2 or less. The dark surface layer is at least twice as thick as the surface mineral layer of soils on adjacent convex micro-positions.

Applicable Subregions: Applicable to all subregions in Alaska.

User Notes: This indicator is found in mineral soils in concave micro-positions in alpine and subalpine areas adjacent to persistent snow packs (Figure 5-5). Seasonal saturation during early summer occurs beneath or immediately down-slope from melting snowbeds. Seasonal saturation causes an accumulation of organic matter within the surface mineral layers. The soil has a dark, organic-rich surface mineral layer that is at least twice as thick as the dark surface mineral soil layer on adjacent convex surfaces. Soils in these landscape positions lack redox features due to low soil temperatures and the masking effects of the high organic matter content. The period of saturation lasts two or more weeks during late May through June.

This indicator is similar to indicator A12 (Thick Dark Surface). The soils occur in concave positions where moisture accumulates. Here the source of hydrology is meltwater from adjacent snow packs that persist well into the growing season. The landscape is usually a complex micro-topography of concave depressions and adjacent convex "micro-highs". Soils should be examined in both landscape positions and compared. If both landscape positions have a mineral surface of the same color, but the layer is at least twice as thick in the concave position, the soil in the concave position is hydric. Make sure that there is evidence of the hydrology source. This includes either direct observation of the melting snow pack or aerial imagery that shows snow pack at that location earlier in the growing season. Likely periods of saturation in each subregion are as follows:

Aleutian Alaska. This indicator is not known to occur in this subregion.

Interior Alaska. Saturation is most likely to be observed during late May through early July. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Northern Alaska. Saturation is most likely to be observed during late May through mid-July. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Southcentral Alaska. Saturation is most likely to be observed during late May through early July. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Southeast Alaska. Unknown, but may exist in alpine areas.

Western Alaska. Saturation is most likely to be observed during late May through June. This is a common indicator in concave micro-positions on mountain slopes and plains where snow accumulates during the winter.

Figure 5-5. The arrows indicate concave micro-positions where water from snowmelt accumulates during late spring and early summer.

Procedure

Soils that meet the definition of a hydric soil but do not exhibit any of the indicators described in Chapter 3 can be identified by the following recommended procedure. This procedure should be used only where indicators of hydrophytic vegetation and wetland hydrology are present but indicators of hydric soil are not evident. Use caution in areas where vegetation and hydrology are also problematic.

1. Verify that indicators of hydrophytic vegetation and wetland hydrology are present.

2. Thoroughly describe and document the soil profile and landscape setting. On the data form or in attached field notes, explain why it is believed that the soil lacks any of the hydric soil indicators given in Chapter 3 and why it is believed that the soil meets the definition of a hydric soil.

3. Use one or more of the following approaches to determine whether the soil is hydric. These approaches are listed in order of increasing strength of evidence.

    a. Verify that the area is in a landscape position that would likely collect or concentrate water (e.g., in a depression or swale, on an active floodplain or low terrace, on a toe slope or in an area of convergent slopes, along the fringe of another wetland or water body, or in an area with a shallow restrictive soil layer). If so, then the soil is hydric.

    b. If the soil is saturated at the time of sampling, alpha-alpha dipyridyl dye can be used in the following procedure to determine if reduced (ferrous) iron is present. If ferrous iron is present as described below, then the soil is hydric.

Alpha-alpha dipyridyl is a dye that reacts with reduced iron. In some cases, it can be used to provide evidence that a soil is hydric when it lacks other hydric soil indicators. The soil is likely to be hydric if application of alpha-alpha dipyridyl dye to mineral soil material in at least 60% of a layer at least 4 inches (10 cm) thick within a depth of 12 inches (30 cm) of the soil surface results in a positive reaction within 30 seconds evidenced by a pink or red coloration to the dye during the growing season.

Using a dropper, apply a small amount of dye to a freshly broken ped face to avoid any chance of a false positive test due to iron contamination from digging tools. Look closely at the treated soil for evidence of color change. If in doubt, apply the dye to a sample of known upland soil and compare the reaction to the sample of interest. A positive reaction will not be present in soils that lack iron. This lack of a positive reaction to the dye does not preclude the presence of a hydric soil. Specific information about the use of alpha-alpha dipyridyl can be found in NRCS Hydric Soils Technical Note 8 (http://soils.usda.gov/use/hydric/ntchs/tech notes/note8.html).

c. Using gauge data, water-table monitoring data, or repeated direct hydrologic observations, determine whether the soil is ponded or flooded, or the water table is ≤12 inches (30 cm) from the surface, for ≥14 consecutive days during the growing season in most years (≥50% probability). If so, then the soil is hydric.

Wetlands that Periodically Lack Indicators of Wetland Hydrology

Description of the Problem

Wetlands are areas that are flooded or ponded, or have soils that are saturated with water, for long periods in most years. Saturation in the root zone leads to anaerobic conditions and the unique vegetation and soil characteristics that are used to identify wetlands in the field. If the site is visited during a time when it is inundated or the water table is near the surface, then the wetland hydrology determination is straightforward. However, many wetlands dry out for part of the year, particularly around their margins where they grade into the surrounding uplands. Furthermore, some wetlands may inundate or saturate only briefly, or not at all, in some years, although they exhibit obvious wetland hydrology during most years in a long-term record.

Wetland hydrology determinations are based on indicators, many of which were designed to be used during drier periods when the direct observation of surface water or a shallow water table is not possible. However, some wetlands may lack any of the listed hydrology indicators, particularly during the normal dry season or in a drier-than-normal year. The evaluation of wetland hydrology requires special care on any site where indicators of hydrophytic vegetation and hydric soil are present but hydrology indicators appear to be absent. This evaluation should consider the timing of the site visit in relation to normal seasonal and annual hydrologic variability, and whether antecedent snowpack and rainfall conditions have been normal.

Procedure

The following recommended procedure may be used whenever wetland hydrology indicators appear to be absent on a site containing hydrophytic vegetation and hydric soil. Note that some of these approaches require meteorological data that may not be available for some sites due to the distance between weather stations in Alaska, the relatively low elevation of most stations, and the effects of topography on local weather patterns.

1. Verify that indicators of hydrophytic vegetation and hydric soil are present, and that the site is in a geomorphic position where wetlands often occur (e.g., depression or swale, level or nearly level area, toe slope, convergent slopes, low terrace, active floodplain or backwater, the fringe of another wetland or water body, or on a soil with a shallow restrictive layer). If these conditions are present, proceed to step 2.

2. Use one or more of the following approaches to determine whether the site is a wetland:

    a. *Site visits during the dry season*. Determine whether the site visit occurred during the normal annual "dry season." The dry season, as used in this supplement, is the period of the year when water tables normally fall to low levels in response to decreased precipitation and/or increased evapotranspiration, usually during the summer. It also includes the beginning of the recovery period in late summer. The following are approximate average dates of the dry season in each subregion (within subregions, actual dates vary by locale and year):

       Aleutian Alaska – no significant dry season
       Southeast Alaska – no significant dry season
       Southcentral Alaska (Anchorage basin) – mid-May through late July
       Interior Alaska – mid-May through late July
       Western Alaska – mid-May through late July
       Northern Alaska – early June through late July

       In many wetlands, direct observation of flooding, ponding, or a shallow water table would be unexpected during the dry season. Wetland hydrology indicators, if present, would most likely be limited to indirect evidence, such as water marks, drift deposits, or surface cracks. In some situations, hydrology indicators may be absent. If the site visit occurred during the dry season on a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation, consider the site to be a wetland. If necessary, confirm the wetland determination by re-visiting the site during the normal wet season and checking again for hydrology indicators.

    b. *Years with unusually low winter snowpack*. Determine whether the site visit occurred following a winter with unusually low snowpack. In portions of Alaska where the snowpack persists throughout the winter, water availability in spring and early summer depends on winter water storage in the form of snow and ice. Therefore, springtime water availability in a given year can be evaluated by comparing the liquid equivalent of snowfall over the previous winter (e.g., October through April) against 30-year averages calculated for National Weather Service meteorological stations (http://lwf.ncdc.noaa.gov/oa/ncdc.html) or for NRCS SNOTEL sites (http://www.wcc.nrcs.usda.gov/factpub/ads/ads_ak.html).

This procedure may not be reliable in areas where the snowpack is not persistent and water is released intermittently throughout the winter.

In years when winter snowpack is appreciably less than the long-term average, wetlands that depend on snowmelt as an important water source may not flood, pond, or develop shallow water tables and may not exhibit other wetland hydrology indicators. Under these conditions, a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation should be considered to be a wetland. If necessary, re-visit the site following a winter with normal snowpack conditions and check again for hydrology indicators.

c. *Periods with below normal rainfall*. Determine whether the amount of rainfall that occurred in the 2-3 months preceding the site visit was normal, above normal, or below normal based on the normal range reported in WETS tables. In areas where the snowpack does not persist over winter, or for sampling dates later in the growing season, WETS tables provided by the NRCS National Water and Climate Center (http://www.wcc.nrcs.usda.gov/climate/wetlands.html) can be used to determine whether rainfall in a given month was normal, above normal, or below normal based on long-term weather records. To determine whether precipitation was normal prior to the site visit, actual rainfall in the current month and previous 2-3 months should be compared with the normal ranges for each month given in the WETS table (USDA Natural Resources Conservation Service 1997, Sprecher and Warne 2000). The lower and upper limits of the normal range are indicated by the columns labeled "30% chance will have less than" and "30% chance will have more than." In Alaska, however, weather stations are widely scattered and data may not be available in some areas.

If precipitation is below normal, wetlands may not flood, pond, or develop shallow water tables and may not exhibit other indicators of wetland hydrology. Under these conditions, a site that contains hydric soils and hydrophytic vegetation and no evidence of hydrologic manipulation should be considered to be a wetland. If necessary, re-visit the site during a period of normal rainfall and check again for hydrology indicators.

d. *Reference sites.* If indicators of hydric soil and hydrophytic vegetation are present on a site that lacks wetland hydrology indicators, the site may be considered to be a wetland if the landscape setting, topography, soils, and vegetation are substantially the same as those on nearby wetland reference areas. Wetland reference areas should have documented hydrology established through long-term monitoring or by repeated application of the procedure described in item *2b* of the procedure for Wetlands that Lack Indicators of Hydrophytic Vegetation in this chapter. Reference sites should be minimally disturbed and provide long-term access. Soils, vegetation, and hydrologic conditions should be thoroughly documented and the data kept on file in the district or field office.

e. *Long-term hydrologic monitoring.* On sites where the hydrology has been manipulated by man (e.g., ditched or leveed) or where natural events (e.g., change in river course, tectonic activity) have altered conditions such that hydrology indicators may be missing or misleading, direct monitoring of surface and groundwater may be needed to verify the presence or absence of wetland hydrology. The U. S. Army Corps of Engineers (2005) provides minimum standards for the design, construction, and installation of water-table monitoring wells, and for the collection and interpretation of groundwater monitoring data, in cases where direct hydrologic measurements are needed to determine whether wetlands are present on highly disturbed or problematic sites. This standard calls for ≥14 consecutive days of flooding, ponding, or water tables ≤12 inches below the soil surface during the growing season at a minimum frequency of 5 years in 10 (≥50% probability). Any area that meets this hydrologic standard and contains hydric soils and hydrophytic vegetation is a wetland.

Wetland / Non-Wetland Mosaics

Description of the Problem

In this supplement, "mosaic" refers to a landscape where wetland and non-wetland components are too closely associated to be easily delineated or mapped separately. These areas often have complex microtopography, with repeated small changes in elevation occurring over short distances. The horizontal distance from trough to ridge may be a foot or less in some areas, such as those with plants growing in tussocks, to 10 feet or more in broadly hummocky areas. Ridges and hummocks are often non-wetland but are interspersed throughout a wetland matrix having clearly hydrophytic vegetation, hydric soils, and wetland hydrology.

Examples of wetland/non-wetland mosaics include many strangmoor/patterned bog systems with flarks (depressions, flooded in spring) and strangs (linear, knee-high ridges, usually oriented at right angles to the original flow of water over the area), frost circles, patterned ground, and other types of periglacial microtopography. Wetland/non-wetland mosaics also occur on dominantly north-facing slopes, burned areas in permafrost-affected regions of Alaska, and discharge slopes on the Kenai Peninsula. In the Anchorage area, wetlands adjacent to streams often contain hummocks associated with the root crowns of trees, and black spruce bogs may contain many knee-high hummocks, usually less than a meter across the top.

Wetland components of a mosaic are often not difficult to identify. The problem for the wetland delineator is that microtopographic features are too small and intermingled, and there are too many such features per acre, to delineate and map them accurately. Instead, the following sampling approach is designed to estimate the percentage of wetland in the mosaic. From this, the number of acres of wetland on the site can be calculated, if needed.

Procedure

First, identify and flag all contiguous areas of either wetland or non-wetland on the site that are large enough to be delineated and mapped separately. The remaining area should be mapped as "wetland/non-wetland mosaic" and the approximate percentage of wetland within the area determined by the following procedure.

1. Establish one or more continuous line transects across the mosaic area, as needed. Measure the total length of each transect. A convenient method is to stretch a measuring tape along the transect and leave it in place while sampling. If the site is shaped appropriately and multiple transects are used, they should be arranged in parallel with

each transect starting from a random point along one edge of the site. However, other arrangements of transects may be needed for oddly shaped sites.

2. Use separate data forms for the swale or trough and for the ridges or hummocks. Sampling of vegetation, soil, and hydrology should follow the general procedures described in the Corps Manual and this supplement. Plot sizes and shapes for vegetation sampling must be adjusted to fit the microtopographic features on the site. Plots intended to sample the troughs should not overlap adjacent hummocks, and vice versa. Only one or two data forms are required for each microtopographic position, and do not need to be repeated for similar features or plant communities.

3. Identify every wetland boundary in every trough or swale encountered along each transect. Each boundary location may be marked with a pin flag or simply recorded as a distance along the stretched tape.

4. Determine the total distance along each transect that is occupied by wetland and non-wetland until the entire length of the line has been accounted for. Sum these distances across transects, if needed. Determine the percentage of wetland in the wetland/non-wetland mosaic by the following formula.

$$\%\ wetland = \frac{Total\ wetland\ distance\ along\ all\ transects}{Total\ length\ of\ all\ transects} \times 100$$

An alternative approach involves point-intercept sampling at fixed intervals along transects across the area designated as wetland/non-wetland mosaic. This method avoids the need to identify wetland boundaries in each swale, and can be carried out by pacing rather than stretching a measuring tape across the site. The investigator uses a compass or other means to follow the selected transect line. At a fixed number of paces (e.g., every two steps) the wetland status of that point is determined by observing indicators of hydrophytic vegetation, hydric soil, and wetland hydrology. Again, a completed data form is not required at every point but at least one representative swale and hummock should be documented with completed forms. After all transects have been sampled, the result is a number of wetland sampling points and a number of non-wetland points. Estimate the percentage of wetland in the wetland/non-wetland mosaic by the following formula:

$$\%\ wetland = \frac{Number\ of\ wetland\ points\ along\ all\ transects}{Total\ number\ of\ points\ sampled\ along\ all\ transects} \times 100$$

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Glossary

This glossary is intended to supplement the one given in the Corps Manual. See the Corps Manual for terms not defined below. Many additional soils terms are defined in USDA Natural Resources Conservation Service (In press).

Cryoturbation. The churning and mixing of soil horizons by frost processes (Williams and Smith 1989).

Folistels. Histels that are saturated with water for less than 30 cumulative days during normal years (and are not artificially drained). See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for a complete definition.

Folistic epipedon. Generally defined as an organic layer that is saturated for less than 30 days cumulative and is 15 cm or more thick. See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for a complete definition.

Histels. Organic soils that contain permafrost. See *Soil Taxonomy* (USDA Natural Resources Conservation Service 1999) for a complete definition.

Permafrost. A thickness of soil or other superficial deposits, or even bedrock, which has been colder than 0 °C for two or more years (Muller 1945).

Seasonal Frost. Any material, including soil, which has a temperature of 0 °C or below for a period of less than one year.

Tree throw. The churning and mixing of soil horizons caused by the uplifted roots of wind-felled trees.

Appendix A – Lists of common plants that occur in wetlands in Alaska by subregions

The following lists of wetland plants include species often encountered during wetland determinations in each subregion of Alaska (no list has been developed for Western Alaska). These lists are not intended to be exhaustive or complete, but may be useful to wetland delineation practitioners with average botanical skills.

Table A-1. Southeast Alaska			
Andromeda polifolia	OBL	*Parnassia palustris*	FACW
Chamaecyparis nootkatensis	FAC	*Picea sitchensis*	FACU
Coptis trifolia	FAC	*Pinguicula vulgaris*	OBL
Drosera rotundifolia	OBL	*Pinus contorta*	FAC
Eleocharis palustris	OBL	*Platanthera stricta*	FACW
Empetrum nigrum	FAC	*Potentilla palustris*	OBL
Erigeron peregrinus	FACW	*Pteridium aquilinum*	FACU
Eriophorum angustifolium	OBL	*Rubus chamaemorus*	FACW
Eriophorum russeolum	FACW	*Sanguisorba canadensis*	FACW
Fauria crista-galli	FACW	*Scirpus cespitosus*	OBL
Fritillaria camschatcensis	FAC	*Swertia perennis*	FAC
Gentiana douglasiana	FACW	*Thuja plicata*	FAC
Hippuris vulgaris	OBL	*Tofieldia glutinosa*	FACW
Iris setosa	FAC	*Trientalis europaea*	FAC
Juniperus communis	UPL	*Tsuga heterophylla*	FAC
Kalmia polifolia	FACW	*Tsuga mertensiana*	FAC
Ledum groenlandicum	FACW	*Vaccinium cespitosum*	FACW
Lycopodium annotinum	FAC	*Vaccinium ovalifolium*	FAC
Lysichiton americanum	OBL	*Vaccinium oxycoccus*	OBL
Menyanthes trifoliata	OBL	*Vaccinium uliginosum*	FAC
Menziesia ferruginea	UPL	*Viola langsdorffii*	FACW
Nuphar luteum	OBL	*Viola palustris*	NI

Table A-2. Southcentral Alaska

Achillea millefolium	FACU	*Equisetum palustre*	FACW
Aconitum delphinifolium	FAC	*Equisetum pratense*	FACW
Alnus sinuata	FAC	*Equisetum scirpoides*	FACU
Alnus tenuifolia	FAC	*Equisetum sylvaticum*	FACU
Andromeda polifolia	OBL	*Equisetum variegatum*	FACW
Anemone narcissiflora ssp. alaskana	UPL	*Erigeron peregrinus*	FACW
Angelica lucida	FACU	*Eriophorum angustifolium*	OBL
Arctagrostis latifolia	FACW	*Eriophorum brachyantherum*	OBL
Artemisia arctica	UPL	*Eriophorum russeolum*	FACW
Artemisia tilesii	UPL	*Eriophorum scheuchzeri*	OBL
Aster sibiricus	FAC	*Galium boreale*	FACU
Athyrium filix-femina	FAC	*Geocaulon lividum*	FACU
Beckmannia eruciformis	OBL	*Geranium erianthum*	NI
Betula glandulosa	FAC	*Geum macrophyllum*	FACW
Betula nana	FAC	*Goodyera repens*	FAC
Betula paprifera	FACU	*Gymnocarpium dryopteris*	FACU
Calamagrostis canadensis	FAC	*Heracleum lanatum*	FACU
Carex aquatilis	OBL	*Hippuris montana*	OBL
Carex limosa	OBL	*Hippuris vulgaris*	OBL
Carex livida	OBL	*Iris setosa*	FAC
Carex lyngbyei	OBL	*Juncus alpinus*	OBL
Carex mertensii	FACW	*Juncus arcticus*	OBL
Carex micropoda	FACW	*Juncus biglumis*	OBL
Carex podocarpa	FAC	*Juncus castaneus*	FACW
Carex rhynchophysa	OBL	*Juncus filiformis*	FACW
Carex rostrata	OBL	*Juncus mertensianus*	OBL
Harrimanella stelleriana	FACU	*Ledum decumbens*	FACW
Castilleja unalaschcensis	FAC	*Linnaea borealis*	UPL
Chamaedaphne calyculata	FACW	*Listera cordata*	FACU
Cornus canadensis	FACU	*Luetkea pectinata*	UPL
Cornus suecica	FAC	*Lupinus nootkatensis*	FAC
Dasiphora floribunda	UPL	*Luzula parviflora*	FAC
Deschampsia cespitosa	FAC	*Lycopodium annotinum*	FAC
Drosera rotundifolia	OBL	*Lycopodium clavatum*	UPL
Dryas drummondii	FACU	*Maianthemum dilatatum*	NI
Dryopteris dilatata	FACU	*Matteuccia struthiopteris*	FACW
Eleocharis palustris	OBL	*Menyanthes trifoliata*	OBL
Empetrum nigrum	FAC	*Menziesia ferruginea*	UPL
Epilobium angustifolium	FACU	*Mertensia paniculata*	FACU
Epilobium latifolium	FAC	*Moneses uniflora*	NI
Equisetum fluviatile	OBL	*Myrica gale*	OBL

Table A-2. Southcentral Alaska (Continued).			
Oplopanax horridus	FACU	*Salix planifolia*	FACW
Parnassia palustris	FACW	*Salix reticulata*	FAC
Picea glauca	FACU	*Salix richardsonii*	FAC
Picea x lutzii	NI	*Salix arbusculoides*	FACW
Picea mariana	FACW	*Salix sitchensis*	FAC
Picea sitchensis	FACU	*Sambucus racemosa*	FACU
Platanthera hyperborea	FACW	*Sanguisorba officinalis*	FAC
Polemonium acutiflorum	FAC	*Sanguisorba canadensis*	FACW
Populus balsamifera	FACU	*Scirpus cespitosus*	OBL
Potentilla anserina	FACW	*Senecio triangularis*	FACW
Potentilla fruticosa	FAC	*Shepherdia canadensis*	NI
Potentilla palustris	OBL	*Sorbus scopulina*	NI
Prunus virginiana	NI	*Spiranthes romanzoffiana*	OBL
Pyrola asarifolia	FAC	*Streptopus amplexifolius*	FAC
Pyrola minor	FAC	*Thalictrum sparsiflorum*	FACU
Ribes glandulosum	FACU	*Thelypteris phegopteris*	UPL
Ribes triste	FAC	*Tofieldia glutinosa*	FACW
Rorippa palustris	FAC	*Triglochin maritimum*	OBL
Rosa acicularis	FACU	*Trientalis europaea*	FAC
Rubus arcticus	FAC	*Urtica dioica ssp. gracilis*	FACU
Rubus chamaemorus	FACW	*Vaccinium oxycoccos*	OBL
Rubus idaeus	FAC	*Vaccinium ovalifolium*	FAC
Rubus pedatus	FAC	*Vaccinium uliginosum*	FAC
Rubus spectabilis	FACU	*Vaccinium vitis-idaea*	FAC
Rumex arcticus	FACW	*Valeriana capitata*	FAC
Salix arbusculoides	FACW	*Viburnum edule*	FACU
Salix arctica	FAC	*Viola epipsila ssp. repens*	UPL
Salix barclayi	FAC	*Viola langsdorffii*	FACW
Salix fuscescens	FACW	*Viola selkirkii*	UPL

Table A-3. Interior Alaska.			
Arctophila fulva	OBL	*Geocaulon lividum*	FACU
Alnus crispa	FAC	*Iris setosa*	FAC
Alnus tenuifolia	FAC	*Juncus alpinus*	OBL
Andromeda polifolia	OBL	*Larix laricina*	FACW
Beckmania eruciformis	OBL	*Ledum decumbens*	FACW
Betula glandulosa	FAC	*Ledum groenlandicum*	FACW
Betula nana	FAC	*Menyanthes trifoliata*	OBL
Betula papyrifera	FACU	*Mertensia paniculata*	FACU
Calamagrostis canadensis	FAC	*Myrica gale*	OBL
Carex aquatilis	OBL	*Nuphar luteum ssp. polysepalum*	UPL
Carex aurea	FACW	*Nymphaea tetragona*	OBL
Carex diandra	OBL	*Parnassia palustris*	FACW
Carex lasiocarpa	OBL	*Picea glauca*	FACU
Carex limosa	OBL	*Picea mariana*	FACW
Carex podocarpa	FAC	*Polemonium acutiflorum*	FAC
Carex rostrata	OBL	*Populus balsamifera*	FACU
Carex vaginata	OBL	*Populus tremula*	FACU
Calla palustris	OBL	*Potamogeton natans*	OBL
Chamaedaphne calyculata	FACW	*Potamogeton richardsonii*	OBL
Cicuta mackenziana	OBL	*Potamogeton vaginatus*	OBL
Cornus canadensis	FACU	*Pyrola asarifolia*	FAC
Drosera anglica	OBL	*Pyrola grandiflora*	FAC
Drosera rotundifolia	OBL	*Rosa acicularis*	FACU
Eleocharis palustris	OBL	*Rubus chamaemorus*	FACW
Empetrum nigrum	FAC	*Rubus idaeus*	FAC
Epilobium angustifolium	FACU	*Salix alaxensis*	FAC
Equisetum arvense	FACU	*Salix arbusculoides*	FACW
Equisetum fluviatile	OBL	*Salix fuscescens*	FACW
Equisetum palustre	FACW	*Salix reticulata*	FAC
Equisetum pratense	FACW	*Salix richardsonii*	FAC
Equisetum scirpoides	FACU	*Typha latifolia*	OBL
Equisetum sylvaticum	FACU	*Vaccinium uliginosum*	FAC
Eriophorum angustifolium	OBL	*Vaccinium vitis-idaea*	FAC
Eriophorum scheuchzeri	OBL	*Viburnum edule*	FACU
Galium boreale	FACU		

Table A-4. Northern Alaska.			
Andromeda polifolia	OBL	*Hippuris vulgaris*	OBL
Arctagrostis latifolia	FACW	*Juncus biglumis*	OBL
Calamagrostis canadensis	FAC	*Ledum groenlandicum*	FACW
Cardamine pratensis	OBL	*Luzula wahlenbergii*	OBL
Carex aquatilis	OBL	*Pedicularis abolabiata*	FACW
Carex podocarpa	FAC	*Pedicularis labradorica*	FACW
Carex rariflora	OBL	*Pedicularis langsdorfii*	FACW
Carex rotundata	OBL	*Potentilla palustris*	OBL
Carex saxatilis	FACW	*Rubus chamaemorus*	FACW
Carex vaginata	OBL	*Salix chamissonis*	NI
Caxex foliolosa	FACW	*Salix fuscescens*	FACW
Dodecatheon frigidum	FACW	*Salix planifolia*	FACW
Equisetum variegatum	FACW	*Saxifraga cernua*	FACW
Eriophorum scheuchzeri	OBL	*Saxifraga rivularis*	OBL
Eriophorum angustifolium ssp. triste	NI	*Sparganium hyperboreum*	OBL
Eriophorum vaginatum	FACW		

Table A-5. Aleutian Alaska.			
Achillea millefolium	FACU	*Eriophorum russeolum*	FACW
Aconitum delphinifolium	FAC	*Festuca altaica*	FAC
Agrostis alaskana	OBL	*Festuca brachyphylla*	UPL
Anaphalis margaritacea	UPL	*Festuca rubra*	FAC
Anemone narcissiflora ssp. alaskana	UPL	*Fragaria chiloensis ssp. pacifica*	UPL
Angelica lucida	FACU	*Fritillaria camschatcensis*	FAC
Antennaria monocephala	UPL	*Galium aparine*	FACU
Arnica chamissonis	FACW	*Galium trifidum*	FACW
Artemisia arctica	UPL	*Geranium pratense*	FAC
Artemisia tilesii	UPL	*Geum calthifolium*	FACW
Athyrium filix-femina	FAC	*Geum macrophyllum*	FACW
Bromus sitchensis var. aleutensis	UPL	*Geum rossii*	FACU
Calamagrostis nutkaensis	FAC	*Heracleum lanatum*	FACU
Calamagrostis purpurascens	UPL	*Hieracium triste*	UPL
Caltha palustris	OBL	*Hierochloe odorata*	FACU
Campanula lasiocarpa	UPL	*Honkenya peploides*	OBL
Cardamine bellidifolia	FAC	*Juncus arcticus*	OBL
Cardamine umbellata	FACW	*Ligusticum scothicum*	FAC
Carex anthoxanthea	FACW	*Listera cordata*	FACU
Carex circinata	UPL	*Lupinus nootkatensis*	FAC
Carex lyngbyei	OBL	*Luzula multiflora*	FACU
Carex macrochaeta	FACW	*Luzula parviflora*	FAC
Carex pluriflora	OBL	*Luzula nivalis*	FAC
Cassiope lycopodioides	UPL	*Lycopodium alpinum*	FACU
Castilleja unalaschcensis	FAC	*Lycopodium annotinum*	FAC
Cerastium beeringianum	FAC	*Mimulus guttatus*	OBL
Claytonia sibirica	FACW	*Pedicularis oederi*	UPL
Conioselinum chinense	FACW	*Pedicularis verticillata*	FAC
Coptis trifolia	FAC	*Petasites frigidus*	FACW
Cornus suecica	FAC	*Phleum alpinum*	FACU
Dactylorhiza aristata	FAC	*Phleum commutatum var. americanum*	FACU
Deschampsia cespitosa ssp. beringensis	UPL	*Platanthera dilatata*	FACW
Deschampsia cespitosa	FAC	*Poa arctica*	FAC
Elymus arenarius ssp. mollis	UPL	*Polemonium acutiflorum*	FAC
Empetrum nigrum	FAC	*Polygonum viviparum*	FAC
Epilobium angustifolium	FACU	*Primula cuneifolia ssp. saxifragifolia*	UPL
Epilobium hornemannii ssp. behringianum	UPL	*Ranunculus occidentalis*	FACW
Equisetum arvense	FACU	*Rhinanthus arcticus*	FAC
Equisetum variegatum	FACW	*Rhododendron camtschaticum*	UPL
Erigeron peregrinus	FACW	*Rubus arcticus*	*FAC*
Eriophorum angustifolium	OBL	*Rubus chamaemorus*	*FACW*

Table A-5. Aleutian Alaska (Continued).			
Rumex arcticus	*FACW*	*Stellaria humifusa*	*OBL*
Salix arctica	*FAC*	*Taraxacum trigonolobum*	*UPL*
Salix reticulata	*FAC*	*Tofieldia coccinea*	*FAC*
Salix rotundifolia	*NI*	*Trientalis europaea*	*FAC*
Sanguisorba canadensis	*UPL*	*Trisetum spicatum*	*FAC*
Sibbaldia procumbens	*UPL*	*Veronica stelleri*	*UPL*
Solidago canadensis var. salebrosa	*UPL*	*Viola langsdorffii*	*FACW*
Stellaria calycantha	*FACW*		

Appendix B – Data Form

WETLAND DETERMINATION DATA FORM – Alaska Region (Field Testing DRAFT)

Project/Site: ______________________ Borough/City: ______________ Sampling Date: ________

Applicant/Owner: ____ Sampling Point: ________

Investigator(s): ______________________ Landform (hillside, terrace, hummocks, etc.): ______________

Local relief (concave, convex, none): __________ Slope (%): _____

Subregion: ________________ Lat: ____________ Long: ____________ Datum: ________

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ______ No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes ______ No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ______	No ______	**Is the Sampled Area a Wetland? Yes ______ No ______**
Hydric Soil Present?	Yes ______	No ______	
Wetland Hydrology Present?	Yes ______	No ______	

Remarks:

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
Total Cover:			
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:			
Herb Stratum			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
Total Cover:			

% Bare Ground in Herb Stratum ________

% Cover of Wetland Bryophytes ________ Total Cover of Bryophytes ________

Dominance Test:

Number of Dominant Species That Are OBL, FACW, or FAC: ________ (A)

Total Number of Dominant Species Across All Strata: ________ (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ________ (A/B)

Prevalence Index:

Total % Cover of:		Multiply by:
OBL species	________	x 1 = ________
FACW species	________	x 2 = ________
FAC species	________	x 3 = ________
FACU species	________	x 4 = ________
UPL species	________	x 5 = ________
Column Totals:	________ (A)	________ (B)

Prevalence Index = B/A = ________

Other Indicators of Hydrophytic Vegetation:
(Record supporting data in Remarks or on a separate sheet.)

___ Wetland Cryptogams

___ Morphological Adaptations

___ Problematic Hydrophytic Vegetation (Explain)

Hydrophytic Vegetation Present? Yes ______ No ______

Remarks:

SOIL

Sampling Point: ____________

Profile Description: (Describe to the depth needed to document the indicator.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol or Histel (A1)
- ___ Histic Epipedon (A2)
- ___ Hydrogen Sulfide (A4)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)
- ___ Alaska Redox (A14)
- ___ Alaska Gleyed Pores (A15)

Indicators for Problematic Hydric Soils[3]:

- ___ Alaska Color Change (TA4)[4]
- ___ Alaska Alpine Swales (TA5)
- ___ Alaska Redox With 2.5Y Hue
- ___ Alaska Gleyed Without Hue 5Y or Redder Underlying Layer
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present.
[4]Give details of color change in Remarks.

Restrictive Layer (if present):

Type: ______________________________

Depth (inches): ______________________

Hydric Soil Present? Yes _____ No _____

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Mat or Crust of Algae or Marl (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C2)
- ___ Dry Season Water Table (C3)
- ___ Unvegetated Concave Surface (D1)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-stained Leaves (B8)
- ___ Drainage Patterns (B9)
- ___ Presence of Reduced Iron (C4)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D2)
- ___ Geomorphic Position (D3)
- ___ Shallow Aquitard (D4)
- ___ Plant Morphological Adaptations (D5)
- ___ Microtopographic Relief (D6)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): ____________

Water Table Present? Yes _____ No _____ Depth (inches): ____________

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): ____________

Wetland Hydrology Present? Yes _____ No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: